Cyclical Variations in the Return Migration of Scottish Salmon by Sea-age c.1790 to 1976

Thesis

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CYCLICAL VARIATIONS IN THE RETURN MIGRATION OF SCOTTISH SALMON BY SEA-AGE c.1790 to 1976

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by

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"Cyclical Variations in the Return-Migration of Scottish Salmon by Sea-Age c.1790 to 1976".

Abstract of the Thesis

The thesis demonstrates by detailed statistics and factual historical comment that the return-migration of the Atlantic salmon of Scotland has varied by sea-age periodically over the past two hundred years or so. The conclusion reached is that such periodic variations by sea-age are a natural characteristic of the salmon run.

The numerical return of the Scottish salmon consists of two principal classes of fish: One that has spent a single winter in the sea after migrating as a smolt ("grilse"), and the other that has spent one winter and a part of a second, or longer, in the sea ("salmon"). Therefore a consideration of periodic variations by sea-age implies a statistical comparison of the numbers of grilse with the numbers of salmon for identical years. This is the method adopted in the thesis which also conforms with the historical method of recording catches.

The thesis identifies to the nearest approximate year or few years the principal cycles of return-migration by sea-age between c.1790 and 1976. Such variations are of major significance to both the commercial and the sporting salmon fisheries.

Other properties of the return-migration are described and discussed, including periodic variations in the seasonal timing of the main migrations of salmon and grilse and periodically varying fish average weights, both important factors affecting the salmon fishery.

Section Headings

"Among objects closely associated with the sublime and beautiful I cannot help classing this noble fish, of which it is my purpose to treat in the following pages....."

- Thomas Tod Stoddart, 1847

INTRODUCTION

The principal and overriding aim of this thesis is to demonstrate, using catch statistics over nearly 200 years together with factual original comment, that the main return-migrations of the Atlantic Salmon in Scotland vary by sea-age cyclically from period to period.

As well as its principal purpose the thesis has (inter alia) two main subsidiary themes. The first is that salmon of the same sea-age classes vary their main seasons of return-migration from period to period. The second is that the average weights of salmon of the same sea-age classes vary from period to period, both dependent on and independent of the time of return-migration, according to period.

A consideration of the varying times of return-migration presents no major problems, but a consideration of varying average weights presents all manner of problems. A main difficulty is that whereas many historical records total every salmon and grilse caught meticulously, often by month, weights of salmon and grilse, where provided at all, are customarily given by way of either totals per season or aggregated together.

The thesis was started with the idea, based on a limited amount of information, that it might be possible to prove that changes in average weights are important linking factors involved in the causality of variations by sea-age in the return-migration. Specifically it was believed that, by considering lengthy cycles as wholes rather than by individual year, it might be possible to demonstrate that salmon and grilse average weights vary intercyclically in relation to each other broadly according to the numerical

proportions of each age-class prevailing in the return-migration from cycle to cycle. The evidence adduced suggests there is no invariable law in this respect, but above all the evidence neither proves nor disproves the theory because there is not enough of it. In order to draw any firm conclusions on the subject it would be necessary to have full details of weights by sea-age and by season for a spread of important rivers over a long period of time, and such information covering several changes of cycle by sea-age is going to be very hard if not impossible to come by.

Nonetheless, the weights investigation does throw light on the nature and possibilities of salmon and grilse weight variation. Some conspicuous trends have been brought out for consideration in the Discussion and Summary of Conclusions, and one doubts if the last word has been spoken on this subject.

Other subjects mentioned briefly in the Discussion are: possible asymmetry in the return-migration following marked changes by sea-age, possible effects of climatic change, variations in the speed of salmon migration through river systems, the effects of U.D.N. on the return-migration as a whole, and a comment on salmon genetics.*

The origins of this investigation lie in the writer's angling experiences on a number of rivers during the years of the mid-1960s, when it became clear that the spring runs were declining and the summer and autumn runs increasing, together with a marked movement to 1SW fish ("grilse") at the expense of 2SW and older stock ("salmon"). Subsequently interest was further stimulated by the sale of certain salmon rod fishings, noted "spring" beats that were already conspicuously in decline, at inflated prices based on their historical

* Since preparing this introduction I have, at the request of my examiners, incorporated a section in the Discussion headed "Factors Influencing the Return Migration".

reputations. (Many spring beats are not good summer-autumn beats, and vice-versa, the staging of the various runs in and through the rivers often being quite different.)

At about the same time one's attention was drawn to the sale during the early 1920s of a beat on the Don (Aberdeenshire) that then had a reputation as an outstanding autumn rod fishing. The price paid was a record for such a fishing. But within a few years the beat had became almost completely worthless since the autumn run had virtually died out. Most of the salmon (2SW and older) were running by then (i.e. by the early 1930s) in the spring and did not stop in that beat any longer in quantity. That this was the true position became clear when the history of the beat was followed up and compared with contemporary events elsewhere on the Don. Subsequently it was established that the same kind of seasonal change had been taking place in other rivers at broadly the same period, combined with a great decline of grilse and an increase of salmon.

Thus was it confirmed that the changes experienced personally during the 1960s had a precedent in something akin to the reverse order during the early part of the century. Ultimately it was decided to investigate these changes on a methodical basis, and to attempt to find out what other major changes might have occurred during the recorded past, and to display their more obvious characteristics and bring out their general nature so far as possible.

The statistical basis to this thesis is entirely the product of field work. Some of the sets of statistics covering the earlier part of the period from the 1780s to 1900 are abstracted from the minutes of evidence submitted to Select Committees of both Houses of

Parliament, established to investigate the state of the salmon fisheries at various periods and to recommend legislation accordingly. These are usually referred to as "Salmon Commissions". But many other sets for this earlier period have also been picked up from various random sources, and many old books had to be bought or borrowed from antiquarian collections for scrutiny. Fortunately the University of Birmingham and the City of Birmingham Reference libraries, at not too far distance from the writer's home, were found to possess between them copies of the 1825, 1836, and 1902 Commission minutes, and also minutes of the 1871 Enquiry. Minutes of the 1860 Commission were found in the British Library, London.

Appendix I to this introduction provides a bibliography of all the sources referred to in the body of the thesis, over the full period c.1790-1976.

After the Elgin Commission reported in 1902 comparatively little information became available from official sources to cover the period 1900-1951. Select Committees to investigate in depth and report on the salmon fisheries were not established during the period. It was therefore necessary to obtain information from private sources, principally the netting records of commercial salmon fishing businesses and estate companies. Representatives of many of these businesses had given evidence in 1900 and 1901 to the Elgin Commission and this undoubtedly provided an impetus to maintaining records of catches on a more methodical basis than hitherto. Consequently some detailed records from these sources have been made available for 1900-1950 and are incorporated into the section III of the thesis.

Expressions of gratitude are due to a number of businesses and

individuals for their assistance and these are given separately in Appendix II.

Since the catch statistics over 1900-1951 are usually though not always available in much greater detail than for earlier periods, three general points are made in relation to them. Most of them have been broken down into the two periods of spring (up to 31st May) and summer (from 1st June). These have been worked on over several years, and if one were starting again they would be broken down ideally for salmon into spring (up to 30th April), May given separately, and summer (from 1st June). This method would have provided a better analysis of the varying quantities of spring and summer fish. It is not highly significant, but May is the great change-over month, and although it has been more traditional in the past to treat May as a spring month, considerable quantities of summer fish (2 + SW and older) may run in May.

The two other points are rather special to the 1900-1950 period. The nets' catches, by which most of the analysis is denominated, do not fully reflect the great increase of winter and early spring fish from c.1920 because many of these ran before the netting started and many more evaded the nets in the high waters of the winter and early spring. Examples of the spring rod catches in the Tweed and Aberdeenshire Dee along with other indications are provided in the text to demonstrate this factor. Regarding the summer catches over c.1920-1950, it is necessary to be aware that during the three month period June to August comprising the summer fishing, the catches for which are sometimes aggregated rather than given separately by month, the August catches greatly declined but the June catches considerably

increased. Attention is sometimes but not invariably drawn to this factor at the appropriate places in the text.

Analysis of the period 1952-1976 is given in outline only by use of the official total Scottish salmon and grilse annual catch statistics, as provided by the Department of Agriculture and Fisheries for Scotland, both in the original form and as adjusted theoretically for the grilse error (an explanation of this is given in Section IV). These records bring out very clearly the general changes by sea-age that occurred in the Scottish fishery as a whole over the period, and also by season of return-migration to a considerable extent. The Department is in the process of analysing by computer the complete Scottish catches 1952-1976, which it began to collect in 1952 under the provisions of the 1951 Salmon Act. In due course they will be made available to interested parties, and then they may be compared with the contents of this investigation covering earlier periods c.1790-1951.

In any case, it would probably not have been possible for the writer to obtain an analysis of the whole period from 1952 up to 1976 himself: The fishing proprietors are protected by the ten year confidentiality clause of the 1951 Salmon Act, and whereas some of them were prepared and pleased to co-operate in regard to earlier periods up to about 1950, they are not generally willing to make available their individual catches of recent years.

At the time of writing it is hoped that statistical information on a few major districts will be made available to attach to the end of Section IV by way of appendices, plus the full rod catches of a whole river over 1952-1976 (included in Section 4) broken down by year and into spring-summer

seasons, but a detailed comparison of events over 1952-1976 with earlier periods will not be available. Such a detailed comparison would have been of greatest use in relation to average weights analysis and theory, but is not necessary in regard to changes by sea-age, for which adequate information already exists and is provided in Section IV.

Reverting to the thesis as a whole, whereas the conclusions, probabilities and possibilities derived and indicated rely on the inductive and deductive methods, assisted where it is necessary to resort to it by analogy, the thesis is also narrative and descriptive. - It tells a story. This policy is adopted on purpose because it is hoped that anglers, sportsmen and other people interested in natural history will read it as well as academics and fish biologists. The conclusions reached are of profound importance to salmon anglers in both the sporting and financial senses if they will take the trouble to read and digest their implications.

Since the writer is in full-time employment and much of the information gathered was during leave entitlements and weekends, the policy adopted to make the most of limited time was wherever possible to photocopy documents at source for home study. The result is that much of the information used in the thesis is available in the original form, the exceptions being where it had to be abstracted by hand from bulky volumes not amenable to photocopying, e.g. the Spey.

The thesis is interdisciplinary, in that it is both a biological analysis and an historical quest. It begins at c.1790 because the late eighteenth century is the earliest time at which reliable records

of catch statistics became available. The division of the thesis into the four sections covering the periods c.1790-1850; 1851-1900; 1901-1951; 1952-1976 is neither fortuitous nor just a matter of convenience, despite appearances. The year 1850 marked the end of a period of great grilse runs and dominance; 1900 marked a significant information threshold, when the Elgin Commission sought to draw up a balance sheet; 1951 saw the passing into law of the Salmon Act that made mandatory the collection of statistics of the total salmon catches by legal means in Scotland by the Department of Agriculture and Fisheries for Scotland, a practice that began with the 1952 season.

The chronology adopted in the thesis is by period and not by river, and stems primarily from the fact that at an early stage of the research it became clear that periodic changes in the return-migration by sea-age occurred at broadly the same times or almost the same times in the principal salmon rivers and districts of Scotland.

Wherever possible information on common rivers has been incorporated into the four chronological sections, so that variations in the return-migration by sea-age and season may be monitored in individual rivers as well as in the whole salmon fishery from period to period. This policy has not always met with success, for a number of reasons. In some instances the full continuous catch statistics do not exist or have not been located; in others the proprietors and lessees of the netting interests have not granted access to them. The search for information has been modelled accordingly in order to yield the best available mix of results.

Reproduction of opinions about the condition of the salmon fishery by the numerous old commentators has been rigorously eschewed.

Some modern commentaries about "the good old days" have relied far too heavily on reproductions of what Grimble or Russel, or whoever, thought about contemporary and past events in their day. Since the old writers did not understand the basic biology of the Atlantic salmon much of their testimony is worthless. On the other hand, where such writers refer to specific factual events that are valid and useful, they are sometimes quoted in this text.

The thesis is a general review of the periodic main variations by sea-age in the return migration of Scottish salmon c.1790-1976, but it does not aim to provide an assessment of the comparative quality and value of the Scottish salmon fishery from period to period. Whereas there is much information in the thesis relating to the size of the fishery by number and weight, investigation with a view to arriving at a valid answer to such a question would preferably require a more acute assessment of factors not undertaken here.

Certain conventions associated with the life-cycle of the Atlantic salmon of Scotland are employed in this thesis. Briefly salmon spawn in the autumn and early winter, the early-running fish spawning first and the late-running fish last. The ova hatch out during the following spring, late March and April, and become fry. At the end of their first year of river life they are known as parr and they continue to be known by this name until they become silver and migrate to sea variously in the springs of their second, third or fourth year of river life, when they are called smolts. There is, therefore, a divided migration of smolts, although most Scottish smolts migrate as two-year olds.

Similarly, there is a divided return-migration of adult fish by age from smolts of a common age. This is traditionally designated by sea-age and not by fish age. The tradition of designation by sea-age became established following the discovery and adoption of scale-reading of adult fish. Sea-age itself is defined by the number of winters a salmon has spent in the sea. Thus a salmon that has spent one winter in the sea before returning to fresh water is known as a one sea-winter salmon, 1SW for short. Similarly with 2SW, 3SW and 4SW salmon. Fish that have spent more than four winters in the sea are so rare in Scotland as to be negligible as a proportion of the total return migration, and 4SW fish are uncommon. The large majority of Scottish salmon return-migrate as 1SW and 2SW fish. 1SW fish are customarily called "grilse"; 2SW and older fish merely as "salmon". This is an historical convention that preceded the use of modern scientific terminology.

Salmon in general do not feed in the sea during the winter months to any substantial extent as affects their weight. Their rapid growing period is during the summer months, when most sea-food is available. Consequently during the winter months their scales do not grow rapidly, but the scales begin to grow rapidly at the onset of the main sea-feeding period during the spring months, when the fish began to increase in weight quickly. Until recently it was customary to reserve the designations 2SW, 3SW, and etc., to non-gravid salmon migrating in the winter and spring months ("spring" fish) that had not re-commenced rapid growth, and that therefore did not show a corresponding growth on their scales. All salmon that had re-commenced a rapid growth, as indicated by scale-reading, were

called "summer" fish and were designated by a + sign after their sea-age, i.e. 1 + SW, 2 + SW, 3 + SW and etc. (Note that in this convention there is no 1SW fish, all grilse being summer fish.) There are a very few 0 + SW fish, i.e. pre-grilse.

It has now become more general practice, for reasons not discussed here, to refer to salmon simply as 1SW, 2SW, 3SW, and etc., fish. However, this thesis adheres to the older convention of designating sea-ages in the form of 1 + SW, 2SW, 2 + SW, 3SW, 3 + SW, and etc., because such a method avoids the need to use continually in a work of this nature tautological expressions such as "spring-running 2SW fish"; "summer-running 2SW fish", and so on. This method was agreed with my external tutor, the late Dr. Arthur Went.

The scientific classes of salmon by sea-age employed in this thesis, together with their corresponding verbal descriptions, are:-

Scientific Class of Salmon by Sea-Age	Verbal Description
1 + SW (One plus sea winter)	Grilse
2SW (Two sea winters)	Small spring salmon
2 + SW (Two plus sea winters)	Small summer salmon
3SW (Three sea winters)	Large spring salmon
3 + SW (Three plus sea winters)	Large summer salmon
4SW (Four sea winters)	Very large spring salmon
4 + SW (Four plus sea winters)	Very large summer salmon

It is common practice to substitute in context the word "salmon" by "fish" in this sequence, e.g. "small spring fish". Despite the distinction adopted between spring and summer fish by the use of the + sign, where in the text the whole seasonal run of a certain age-class of fish is referred to, the terms 1SW, 2SW,

3SW, and etc., may occasionally be employed, in order to avoid the use of cumbersome phrases such as "the whole 2SW/2 + SW run."

In general, a very few "summer" salmon may begin to show up before April, but their numbers usually begin to increase significantly as April advances. May is the main change-over period from "spring" to "summer" fish, and by the end of May there are usually few "spring" salmon still running. In some sets of statistics of this thesis, particularly over 1900-1951, the "spring" terminates at 31 May, and "summer" begins promptly on 1 June. However, usually the spring fish remain in the majority until the second or third week of May. In some of the netting catch statistics, therefore, there is a slight imbalance in the "spring", but this does not make a highly significant difference to comparisons. In the rods catch statistics there is an imbalance the other way, since many spring fish may be caught in June, even July.

Other terms used in the thesis are "clean" fish, "gravid" fish, and "kelt". A kelt is a spawned salmon that has not yet returned to the sea. "Clean" and "gravid" are terms that are used ambiguously by various writers. In this thesis "clean" is employed as a synonym for "spring" fish, to distinguish them from kelts. The term "gravid" describes fish blown out with spawn or milt, shortly or not long before spawning. Where the neologism "geophysical" is used, reference is meant to the general physical characteristics of a river system in their widest sense as may affect the return-migration of the system.

As a result of the inherent nature of the Scottish salmon migration a study of variations in the overall return-migration by

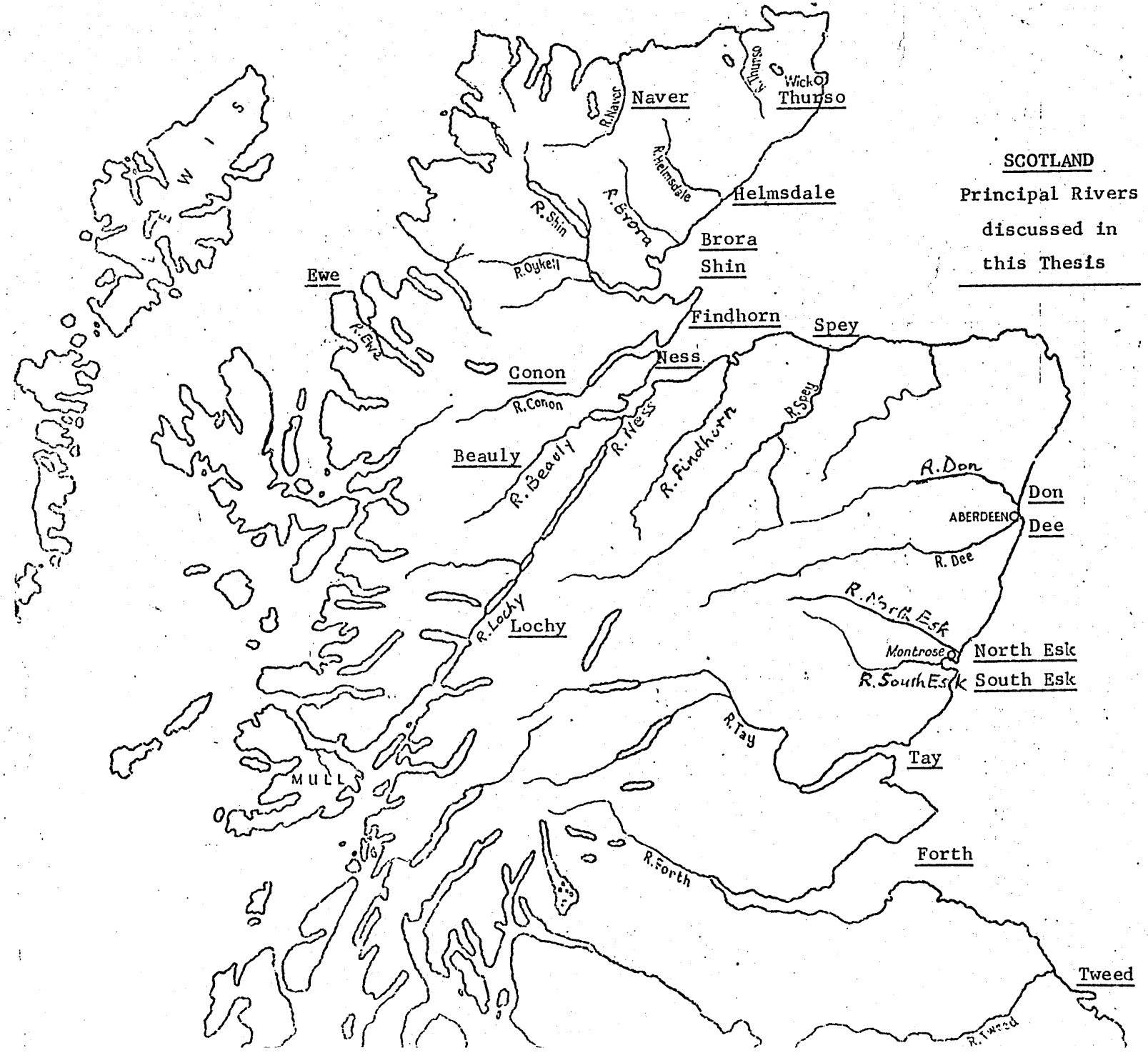
sea-age and by number and weight is necessarily resolved primarily into an analysis of the periodic changes in the numbers of 1SW fish and the numbers of 2SW fish, since fish of these two sea-ages at all times together constitute the large majority by number and by weight of the whole return-migration. Regarding the Scottish salmon fishery as a whole, it is a convention of the thesis that 3SW and older fish are residual stock which are usually present in the return-migration in modest numbers at periods when there are many 2SW fish. At periods when 1SW fish are dominant in the return-migration there tend to be very few 3SW and older fish. The thesis does have something to say intermittently about the presence of and variations in the 3SW and older stock.

Dr. Went raised the question with the writer as to how one could be certain in historical records that all fish classed as salmon (i.e. 2SW and older) actually were salmon and that all fish classed as grilse (1 + SW) actually were grilse. (Dr. Went was well aware that during the great grilse period of the 1960s and 1970s numerous heavy grilse were classed by the commercial fishers as salmon throughout Britain and Ireland). The answer is that sometimes one cannot be certain. It is clear that there must have been a margin of error existing in past records, a margin that varied from period to period primarily according to variations in the grilse migration. However, it is believed for reasons that are self-evident in the thesis that this problem presents no insurmountable barrier to a valid interpretation of the main periodic variations by sea-age in the return-migration.

The physical map of Scotland shows that, except for the Grampian

massif, the main mountain backbone of Scotland is down the western side of the country. Many of the rivers flowing to the east are, therefore, long and big rivers, whereas most of the rivers flowing to the west are short and small (see map next page). The main salmon-yielding districts are consequently on the eastern side of the country, both for net and rod. The convention of this thesis is that there are four salmon fishing regions or major districts to the Scottish salmon fishery. The two minor ones, that together account for only a small part of the total produce, and of which little is said in the thesis, are broadly those of (a) the north-western and western coasts down to the Clyde; and (b) the south-western coasts extending south of Clyde round the Solway Firth to the English border.

The two major districts extend from Tweed on the east coast round to the Naver and the Borgie on the north coast. The more important of these districts, and the main salmon district overall, is that which extends from Tweed to the Findhorn in the Moray Firth. This district includes the great majority of the bigger rivers and, viewed as a whole, has its own particular characteristics. In this district salmon tend to run throughout the season, and there are great variations in the quantities and proportions of salmon and grilse periodically, as well as big variations in the seasons of return-migration, particularly for salmon. In the lesser major district, from Ness round to Naver/Borgie (but specifically excluding the Ness, which is a special river system), the main salmon migration tends to be concentrated more into the spring and early summer months, and, although these runs experience the same changes at broadly the same times as the southern rivers, at most


SCOTLAND
Principal Rivers
discussed in
this Thesis
Naver
R.Naver
Thurso
R.Thurso
Wick
Helmsdale
R.Helmsdale
Brora
R.Brora
Shin
R.Shin
R.Oykell
Ewe
R.Ewe
Findhorn
R.Findhorn
Spey
R.Spey
Ness
R.Ness
Conon
R.Conon
Beauly
R.Beauly
Don
R.Don
ABERDEEN
Dee
R.Dee
North Esk
R.North Esk
Montrose
South Esk
R.South Esk
Lochy
R.Lochy
Tay
R.Tay
MULL
Forth
R.Forth
Tweed
R.Tweed

periods a better balance seems to be preserved between salmon and grilse in many though not all of the rivers. Of course, there are many local variations, and hydro-electrification may (or may not) have influenced the salmon-grilse balance in rivers such as Beauly, Conon and Shin since the 1950s.

Contrary to popular assumption salmon rod fishing as a popular sport is a modern sport, growing entirely within the bounds of last century, and the essential outline of this growth is described in a chapter at the end of Section II.

The principal theme of the periodic variations by sea-age in the return-migration is mentioned only briefly, without references to the text, as the first item in the Discussion, since there is nothing to discuss. These variations are factual events which the statistics and supporting comment describe chronologically by section. The dates of the cyclical changes by sea-age to the nearest year or few years are then summarised in the Summary of Conclusions.

The Discussion devotes more space to the two main subsidiary themes: variations in seasonal timing of return-migration and variations in fish average weights, since the factual nature of these events, their timing and implications, are more debatable. References are made to the text where considered necessary, but are kept to a minimum.

APPENDIX I

Origins of Source Documents Referred to in this Thesis

Section I (c.1790 - 1850)

Minutes of the Report from the Select Committee on the Salmon Fisheries of the United Kingdom 1824-25, and subsequent Parliamentary stages, as indicated in the text.

J. Cornish: "The Present State of the Salmon and Channel Fisheries, 1824.

Sir H. Davy: "Salmonia", 1828.

M. Mackenzie: "The Salmon Fishery of Scotland", 1830.

Minutes of the Report from Select Committee on Salmon Fisheries, Scotland, 1836.

W. Scrope: "Days and Nights of Salmon Fishing in the River Tweed", 1843.

J. Wilson: "Rod and Gun", 1844.

A. Russel: "The Salmon", 1864.

T. Ashworth: "The Salmon Fisheries of England", 1868.

A. Young: "Sea and Salmon Fisheries" (British Industries Series), 1877.

The Annual Reports of the Fishery Board for Scotland for the years 1883, 1884, 1889.

Minutes of the Report of the Commissioners on Salmon Fisheries, 1902.

A. Grimble: "The Salmon Rivers of Scotland", 1913.

The Fishing Gazette, Vol. 62, 1916.

W. Calderwood: "Salmon and Sea Trout", 1930.

Section II (1851 - 1900)

Minutes of the Salmon Commission 1824-25.

Minutes of the Report from the Select Committee on the Salmon Fisheries, Scotland, 1860.

Minutes of the Report of the Special Commissioners, 1871 (being an Enquiry into the operation of the Scottish salmon legislation of the 1850s and 1860s).

Minutes of the Salmon Commission 1902.

The Annual Reports of the Fishery Board for Scotland for the years 1883, 1884, 1885, 1889, 1892, 1896, 1900.

Records of the Aberdeen Harbour Board.

Sir H. Davy: "Salmonia", 1828.

J. Younger: "On River Angling for Salmon and Trout", 1840.

W. Scrope: "Days and Nights of Salmon Fishing", 1843.

T. T. Stoddart: "The Anglers Companion", 1853 (1923).

A. Russel: "The Salmon", 1864.

A. Young: "Sea and Salmon Fisheries", 1877.

W. Henderson: "My Life as an Angler", 1880.

J. W. Willis Bund: "Salmon Problems", 1885.

The Fishing Gazette: Vol. 11, 1885; Vol. 29, 1894.

J. P. Traherne: "The Habits of the Salmon", 1889.

A. E. Gathorne-Hardy: "The Salmon", 1898.

Sir H. Maxwell F.R.S: "Salmon and Sea Trout", 1898.

W. Calderwood: "The Salmon Rivers and Lochs of Scotland", 1909.

P. D. Malloch: "The Life History and Habits of the Salmon", 1909.

A. Grimble: "The Salmon Rivers of Scotland", 1913.

A. Ransome: "Mainly About Fishing", 1959.

Section III (1901 - 1950)

The Annual Reports of the Fishery Board for Scotland for the years 1903-14, 1921, 1927, 1934, 1937, 1938, 1948, 1950.

J. Johnston and Sons Ltd: Records

The Lovat Estates Company: Records

The Crown Estate Commissioners: Records

The Aberdeen Harbour Board: Records

The Thurso Estates Company: Records

Confidential Sources (i.e. requested anonymity).

Investigations into various Rivers by the Scottish Inspectorate of Salmon Fisheries, as indicated in the text.

The Scotsman Newspaper.

The Annual Report of the Fishery Board for England and Wales, 1876.

J. Dearman, Esq., of Peterborough.

W. Calderwood: "The Salmon Rivers and Lochs of Scotland", 1909.

The Salmon and Trout Magazine, 1922 (Annual Compendiam).

W. J. M. Menzies: "The Salmon", 1931.

J. Scott: "Greased Line Fishing for Salmon", c.1935.

J. Scott: Game Fish Records", c.1935.

Section IV (1951 - 1976)

All the statistical information incorporated into this section has originated directly or indirectly with the Department of Agriculture and Fisheries for Scotland, particularly with the office of the Inspector of Salmon and Freshwater Fisheries and with the Freshwater Fisheries Laboratory at Pitlochry.

APPENDIX II

Acknowledgments

This thesis could not have been prepared without the co-operation and help provided by a number of individuals and organisations. I am particularly grateful to the following:-

1. The directors of Messrs. Joseph Johnston and Sons Ltd., salmon fishers, and particularly to Mr. J.R.W. Stansfeld, who allowed me the run of their records office at Montrose and otherwise offered every encouragement.
2. Mr. R.M. Clark F.R.I.C.S., Associate of Messrs. Smiths Gore, Chartered Surveyors, who at no little inconvenience to himself arranged access for me in Scotland to the Spey netting records of the Crown Estate Commissioners (referred to in the text by their historical name of the Gordon-Richmond net fishings).
3. The Lord Lovat and his son the Master of Lovat for authorising access to the River Beauly catch records, and Mr. G.A. Foster, Factor, Lovat Estates, for preparing the statistics in a form suitable for use.
4. The Aberdeen Harbour Board for providing the Aberdeenshire Dee netting records together with permission to reproduce them, and particularly to the Secretary of the Board, Mr. J.R. Scott.
5. Mr. Robert Williamson, Inspector of Salmon and Freshwater Fisheries for Scotland, for the statistics and papers sent at various times from which the outline picture over 1951-1976 has been compiled.

6. Dr. Derek Mills of the Department of Forestry and Natural Resources, Edinburgh University, who made available two detailed sets of rod-catches for the river Tweed, provided to him by sources who wish to remain anonymous.

Many other people and institutions have been most helpful, not excluding the librarians and staff of Birmingham University Library, City of Birmingham Central Reference Library and The British Library, London.

Since he has recently died, I feel I should also express gratitude to Dr. Arthur Went, my external supervisor, who was deeply interested in the subject of this thesis and who offered detailed advice and encouragement in writing, at our meetings and by 'phone from his Dublin residence. My internal supervisor, Dr. Margaret Varley (= Brown), I particularly thank for her help in reconciling the findings of the thesis with genetical and environmental factors thought to influence the salmon return migration.

The rod catch statistics for the river Thurso over the period 1922-1950 were provided to me some years ago by the then River Superintendant, Mr. Sutherland. The Thurso rod catches 1951-1976 have been collected from "The Fishing Gazette", "Trout and Salmon", and promotional literature published periodically by the Thurso Estates Company, and all statistical information covering 1900-1976 originated with the Thurso Estates Company.

CYCLICAL VARIATIONS IN THE RETURN

MIGRATION OF SCOTTISH SALMON

BY SEA-AGE

c. 1790 TO 1976

SECTION I: c. 1790 - 1850

Section I

Chapter Headings

1. Introduction

It is reasonable to begin a study of changing patterns of the salmon return migration by sea-age at 1790 or thereabouts, because prior to this time, and certainly prior to the 1780s, reliable statistics on salmon catches do not appear to exist. Towards the close of the eighteenth century Robert Dempster, Laird of Dunichen (or Dunnichen) started to pack in ice the nets' catches from the Scottish summer run for distribution fresh to distant English markets, particularly to London by boat. Previously only early-running fish caught before the onset of summer had been transported south in fresh condition. The summer run had at that time been sold locally very cheaply or pickled and salted before distribution MacKenzie (1830, 6-7); Russel (1864, 4); The Fishing Gazette (1916, 257).

Following Mr. Dempster's seminal innovation, commercial salmon fishing rapidly became a highly lucrative trade, the prices obtainable for fresh salmon in the southern markets being much higher than for pickled or salted fish. A policy of recording salmon catches by number or weight or both followed on the great increase in the value of the commodity, at least in most of the major rivers, and in some of the lesser fisheries also, though not always on a continuing basis.

This new market development dated from the 1780s but major changes did not begin to take place until the 1790s and thereafter. A letter written in 1788 describes the Tweed salmon net fishery at Berwick, the nearest of the principal Scottish fisheries to London, and states unequivocally that when the "hot season comes in" salmon "can no longer be sent fresh up to town" (i.e. London). (Fishing Gazette, 1916, 257). The letter also

graphically illustrates the low prices then paid for summer fish, which could not at that date be transported fresh to wealthy southern markets, and the high prices obtainable for spring fish, which would be shipped to wealthy markets during the colder season. From shortly before the turn of the century in the Tay and shortly after in the Tweed, Spey, and many other rivers, statistics of the catches in estuary and lower-river net fisheries were maintained, though not always or indeed often in an ideal form for comparison.

Not all extant records over the period c.1790 - 1850 employed in this section comprise the total produce of the various fisheries considered. Moreover, not all records are continuous, since fisheries changed ownership and not every proprietor bothered to keep records. Of those that were kept, many are now destroyed or lost. Again, many records are too inadequate or fragmentary to be used in an investigation of this nature.

There is also a reason for concluding the period at 1850. Evidence will be offered in a subsequent section that the 1850s marked the watershed of a prevailing pattern of more than thirty years' duration.

2. The Coastal Nets

Enhancement of the value of fresh salmon quickly led not only to more intensive exploitation of the stocks by the traditional methods of estuary and lower-river netting with the conventional sweep (i.e. draft, seine) nets, but also shortly afterwards to the introduction on the eastern shores of Scotland

of coastal fixed nets. (In this thesis except when stated the term 'fixed' net is employed as a generic term covering stake nets, bag nets and fly nets.)

In "The Salmon" (1864) Alexander Russel traced the stake-net of the modern type back to its introduction into the Solway in 1788, where its efficiency greatly reduced the catches of the existing kinds of net. In the minutes of the 1825 Salmon Commission it is recorded that stake nets were introduced into the Firth of Tay (i.e. the lower Tay estuary) in 1799 but were declared illegal in 1812 by the Court of Session following a lengthy legal action brought by an upper-estuary proprietor. Russel records that stake nets were first erected on the eastern open sea-shore in 1821 at "Dunninald in Forfarshire" (now north Tayside), always since a prolific centre of coastal salmon fishing (Russel, 1864, 189). Opinion at the time was that these coastal nets were illegal, since all salmon fishings in Scotland were the property of the Crown, a species of property distinct from land and requiring a special grant. But, contrary to the position in England and Wales where stake nets were outlawed by the Salmon Act of 1861, in Scotland these nets and bag and fly nets became institutionalised, except within estuaries where, as the result of the Tay ruling, they remained illegal.

It is not a purpose of this thesis to investigate the development of the coastal salmon fishery in any detail, other than to make two observations on aspects of coastal salmon fishing in Scotland that might have a bearing on the catch statistics employed in the thesis, which statistics primarily

(particularly in this section) relate to estuary and lower-river net fisheries:-

(a) While it would be most difficult to form a reliable assessment of the effect of the coastal nets' catches on the estuary and lower-river catches in a quantitative sense, it is clear that this effect must have become quantitatively considerable as the century progressed. The development of the new fishery gradually from the beginning of the period under study is a reason, probably a principal reason, why the great quantities of salmon and grilse recorded as taken in the Tweed and other rivers up to the 1820s in the estuary and lower-river fisheries were not repeated thereafter at any other period during the course of the century.

(b) The growth of the coastal nets fishery did not in itself influence to any significant degree the capacity of the estuary and lower-river nets fisheries to reflect the changing patterns of the salmon runs. The coastal nets catch both spring - and summer - running fish, though overall they tend to exploit the summer runs to the greater extent. Within the estuaries there is a tendency for the lower estuary nets to exploit best the summer runs and for the upper - estuary and lower - river fisheries to exploit best the spring runs, solely as the result of seasonal climatic factors. This is an important reason for obtaining, wherever possible, the full catch returns for any combined estuary and lower river net fishery. Ideally statistics from coastal net fisheries contiguous to any

estuary are also desirable, but this is not usually possible because not only is the ownership and operation of estuary and coastal nets often quite different but the various coastal net fisheries of a locality are customarily let to different netting interests within quite short distances. Indeed, it is often difficult to gain access even to a single set of coastal nets in a district, so zealously are details of the historical catches preserved by most of the netting lessees in Scotland. However, details of some coastal catches will be analysed in subsequent sections of the thesis. During the period under immediate investigation the coastal nets fishery was in its infancy until the 1820s and 1830s.

Evidence will be adduced later indicating that variations in the catch statistics of the estuary and lower-river net fisheries after 1850 were reflected in the Billingsgate combined returns of Scottish salmon from both estuary and coastal fisheries, thus demonstrating that the existence of the coastal fisheries did not to any overriding degree warp the return-migration pattern as indicated in the returns of catches from the estuary and lower-river nets.

3. Net Fisheries of the Estuaries and Lower Rivers

Statistics of catches made in estuary and river fisheries of major Scottish rivers of the first class of productivity have been identified from various sources in whole or in part over the period from their commencement c. 1790 to 1850. These rivers are Spey, Tweed, Aberdeenshire Dee and Tay, not in any order of

precedence. There are also statistics from similar fisheries in five lesser but prolific rivers over the period: Beauly, Helmsdale, Brora, Findhorn and Don. These nine rivers cover a wide spread of regions between the Border country and Caithness (see Map earlier). All these rivers flow to the east coast.

The catch statistics are provided in summary form, together with their source references, in a manner as near as possible comparable to each other.

Spey

The catches provided covering the period 1810 to 1850 were submitted to the Elgin Salmon Commission by a representative of a famous family of salmon net lessees (Hogarth) with franchises in the estuaries and lower reaches of many Scottish rivers, including the exclusive rights in the Duke(s) of Richmond and Gordon's lower Spey net fishery at Gordon Castle. The Spey has no estuary, running directly into the sea, and the netting area was from the mouth up to a cruive - dyke fishery (long ago abandoned and demolished) not far from the mouth, the property of their Graces, who also owned the foreshore around Spey - mouth where they restricted the operation of stake nets in the vicinity of the river.

(Cont.....)

Table 1

Weights of Fish caught in River Spey Nets

(Source: Salmon Commission, 1902, 525)

Annual Averages at 10 Yearly Intervals	Salmon		Grilse	
	lbs		lbs	
1810 - 1819	231,152	58%	168,721	42%
1820 - 1829	198,851	40%	295,725	60%
1830 - 1839	183,339	41%	260,644	59%
1840 - 1849	140,263	40%	206,948	60%

The at - a - glance implications of Table 1 were summed up laconically by Mr. Hogarth himself before the Commission: "The salmon have decreased and the grilse have increased". (Ibid., 1902, 525).

Tweed

The Tweed, like the Spey, has no significant estuary, but the effect of the tide extends much higher upstream. Although stake-nets were introduced during the course of the century north and south of Tweed-mouth the statistics submitted appear to relate entirely to fish caught "in the river" :-

(Cont.....)

Table 2

Numbers of Fish caught in River Tweed Nets

(Source: Fishery Board for Scotland, Annual Report, 1889, 42)

Annual Averages at 10 Yearly Intervals	Salmon		Grilse	
1808 - 1809 (2 years)	34,141	54%	29,001	46%
1810 - 1819	40,367	36%	70,857	64%
1820 - 1829	18,454	23%	61,817	77%
1830 - 1839	13,732	19%	60,138	81%
1840 - 1849	15,302	18%	70,444	82%

There was a decline of salmon, even more marked than in the Spey; the grilse catches were remarkably consistent, at least in the form of 10 yearly averages. The first big grilse year recorded was 1812. The average annual grilse catch over the four years 1808 - 1811 inclusive was only 33,047, which was lower than for any subsequent four-year sequence right up to 1850. On the other hand, the average salmon catch over the four years, at 36,908 (53%), was greater than the grilse catch (47%). A similar pattern can be observed in other rivers cited in this section over the same period.

It is a reasonable inference that the great increase of the grilse evident in the Spey statistics during the period 1820-1829 began at a slightly earlier period in the Tweed (and in some other rivers).

Aberdeenshire Dee

Two different sources offer information that covers the runs up to the year 1835 (but there are no later statistics to 1850). First, the numbers caught by four estuary fisheries, the Raick, Midchingle, Pott and Foord's were provided to the 1825 Commission by Mr. G. Hogarth for the period 1790-1824.

Table 3
Numbers of Fish caught in River Dee Nets
(Source: Salmon Commission, 1825, 93)

Average of Years	Salmon		Grilse	
From 1790 to 1800	21,260	59%	14,980	41%
" 1801 to 1812	18,962	53%	17,013	47%
" 1813 to 1824	19,120	37%	32,742	63%

There was a marked proportionate shift to grilse at about the same time as in Spey and Tweed, particularly the former. This is brought out by a breakdown of the last twelve year period 1813 - 1824 :-

Table 4
Numbers of fish caught in River Dee Nets
(Source: Salmon Commission, 1825, 97)

Six-Yearly Averages	Salmon		Grilse	
From 1813 to 1818	23,470	39%	36,169	61%
" 1819 to 1824	14,792	34%	29,244	66%

During the years 1813-1818 there was a high overall return-migration that masked the decline of salmon as a proportion of the total run.

To the 1836 Salmon Commission Mr. G. Davidson submitted details of catches at the Inch of Culter, a Dee net fishery referred to as an "upper fishery", that is, in fresh water at about the limit of tide-influence. Mr. Davidson's catches covered the twenty-one year period 1815 to 1835 (see Table 5) :-

Table 5

Weights of Fish caught in a R.Dee Upper Nets Fishery

(Source: Salmon Commission, 1836, s.2615)

Seven-Yearly Averages	Barrels of Salmon & Grilse
From 1815 to 1821	23¾
" 1822 to 1828	15
" 1829 to 1835	8¼

A barrel of salmon or grilse contained 400 lbs.

Mr. Davidson replied to questions from the chairman of the Select Committee about these catches:-

Q. Is it your opinion that there has been a gradual and decided decrease in the produce of the upper fisheries of the Dee?

A. Yes, for a considerable time past.

Q. From what time do you date the decrease?

A. From 1817 there has been a progressive falling off in the upper fisheries.

Q. What do you ascribe that to?

A. I ascribe it to the change in the produce, the falling off of the salmon and the increase of the grilses; the upper fishings were most successful in the spring when the salmon were abundant; the salmon have fallen off, and the grilses have increased (Salmon Commission, 1836, s.2615).

In other words, during the dry season the grilse were best caught in the lower estuary, but in the spring the customary sufficiency of water drew the fish rapidly into the river where the lower-river nets caught best.

In conclusion, there was a marked general similarity of the run patterns in the Dee 1800-1835 with those of Spey and Tweed. There was a decline of salmon and an increase of grilse that becomes progressively more conspicuous throughout the 35 year period, indeed over 50 years since the 1780s. The comparative total quantities of salmon and grilse caught in the Raick fishery of the Dee for the two seven year periods 1786-1792 and 1818-24 were:-

Table 6
Annual Weights of Fish caught in Part of R.Dee Nets
(Source: Salmon Commission, 1825, 98-99)

Total of Years	Salmon (lb)		Grilse (lb)	
7 Years 1786 - 1792	1,068,357	87%	158,046	13%
7 Years 1818 - 1824	692,269	56%	546,244	44%

Don

The river Don enters the sea within a short distance from Dee-mouth. Although of lesser volume than the Dee it is, or was, a prolific salmon river. Available statistics are restricted to the period 1790 to 1824 and no other supporting subsequent information has been obtained.

Table 7
Numbers of Fish caught in River Don Nets
(Source: Salmon Commission, 1825, 93)

Average of Years	Salmon		Grilse	
From 1790 to 1800	23,312	54%	19,928	46%
" 1801 to 1812	15,229	47%	17,108	53%
" 1813 to 1824	12,665	31%	28,012	69%

The movement to grilse was even more marked than in the Dee over the same period.

Beauly

The Beauly is not a river of the volume of Spey or Tweed but it is nevertheless by Scottish standards a big river in its lower reaches. The principal proprietor on the lower river was, and is, Lord Lovat, who during the period under review had a cruive-dyke fishery near the mouth of the river.

The statistics are in two sets, and cover only a part of the period 1800-1850. The first set in Table 8 is for the seven years 1809-1815. The second set in Table 9 covers the fourteen years 1822-1835 inclusive, and was submitted to the 1836 Salmon Commission.

Table 8

Numbers of Fish caught in River Beauly Nets

(Source: Sea and Salmon Fisheries, British Industries, 1877, 279)

Annual Catch	Salmon		Grilse	
1809	5,543	70%	2,369	30%
1810	3,908	62%	2,412	38%
1811	3,548	59%	2,482	41%
1812	2,642	28%	6,672	72%
1813	2,682	29%	6,442	71%
1814	2,100	19%	9,000	81%
1815	2,240	19%	9,300	81%

These 1809-1815 catches show a remarkable decline of salmon and increase of grilse at just the same period as in the Tweed and other rivers.

Table 9

Numbers of Fish caught in River Beauly Nets

(Scurce: Salmon Commission, 1836, Appendix No. 11, 330)

Average of Years	Salmon		Grilse	
Five Years 1822 - 1826	2,459	24%	7,586	76%
Five Years 1827 - 1831	1,678	17%	8,036	83%
Four Years 1832 - 1835	2,338	18%	10,559	82%

The figures of 1822-1835 indicate that the increase of grilse experienced over the years 1812-1815 was sustained throughout the subsequent twenty years to 1835.

Helmsdale

The Helmsdale is a quite small but productive Sutherland salmon river long famous for angling sport both in spring and summer. The nets' catch statistics provided from the 1836 and 1902 Salmon Commissions are in two sets covering the period 1807 to 1849, excepting the three years 1818-1820 for which the catch details were lost. Numbers of fish caught are available only to 1835; thereafter to 1849 the average weight of all the fish caught, by season, has to suffice. To assist with the comparison the average weights are provided over the full period 1807-1849, less 1818-1820.

Table 10
Numbers of Fish caught in River Helmsdale Nets
(Source: Salmon Commission, 1836, 323)

Average of Years	Salmon		Grilse	
5 Years 1807 - 1811	2,763	(54%)	2,376	(46%)
6 Years 1812 - 1817	2,335	(35%)	4,409	(65%)
5 Years 1821 - 1825	1,319	(36%)	2,352	(64%)
5 Years 1826 - 1830	946	(24%)	3,031	(76%)
5 Years 1831 - 1835	1,037	(25%)	3,102	(75%)

Table 11

Average Annual Weights of Fish caught in River Helmsdale Nets

(Source: Salmon Commission, 1902, Appendix No. 24, 51)

Average of Years	Average Annual Weight per fish
5 Years 1807-1811	7.01 lbs
6 Years 1812-1817	6.33 lbs
5 Years 1821-1825	6.15 lbs
" 1826-1830	6.34 lbs
" 1831-1835	6.02 lbs
" 1836-1840	6.27 lbs
" 1841-1845	5.90 lbs
4 Years 1846-1849	6.13 lbs

From 1807 to 1835 by numbers of fish there was a substantial decline of salmon and a corresponding increase of grilse measured as percentage proportions of the total catch. After 1835 there was a gradual decline in the total annual catches by weight, as submitted in evidence to the 1902 Commission, but no remarkable change in the annual average weights per unit fish, thus indicating that the grilse dominance endured through to at least 1849.

Brora

The Brora is located some distance south of the Helmsdale on the north-east coast. It is not markedly dissimilar in volume nor in the habits of its salmon. The first set of nets' catch statistics is from the same source as for the Helmsdale and is for the same two periods covering 1807 to 1849, excepting 1818 to 1820. Again,

numbers of fish caught are available only to 1835; thereafter by fish weight.

Table 12

Numbers of Fish caught in River Brora Nets

(Source: Salmon Commission, 1836, Appendix No. 1, 322)

Average of Years	Salmon		Grilse	
5 Years 1807 - 1811	1,914	(53%)	1,676	(47%)
6 Years 1812 - 1817	1,434	(36%)	2,603	(64%)
5 Years 1821 - 1825	1,022	(30%)	2,429	(70%)
5 Years 1826 - 1830	733	(24%)	2,290	(76%)
5 Years 1831 - 1835	1,329	(24%)	4,131	(76%)

Table 13

Average Annual Weights of Fish caught in River Brora Nets

(Source: Salmon Commission, 1902, Appendix No. 24, 53)

Average of Years	Average Annual Weight per fish
5 Years 1807 - 1811	6.98 lbs
6 Years 1812 - 1817	6.46 lbs
5 Years 1821 - 1825	6.08 lbs
5 Years 1826 - 1830	5.98 lbs
5 Years 1831 - 1835	5.63 lbs
5 Years 1836 - 1840	5.98 lbs
5 Years 1841 - 1845	6.09 lbs
4 Years 1846 - 1849	6.36 lbs

There was a substantial proportionate decline of salmon progressively from the early years, and a corresponding increase of grilse. The whole picture is acutely similar to the Helmsdale. Total annual catch weight began to decline after 1837. There was a modest increase in the weight per fish 1846-1949 over the average for the previous 25 years, but this is hardly indicative of any major change in the patterns of the runs.

A further set of statistics, also submitted to the 1825 Commission, but at a different time and from a different source, provides information on the Brora for the period 1792-1804 inclusive. As the grilse were sometimes included in the total catch with the salmon and sometimes shown separately the average fish weights only are listed below:

Table 14

Average Annual Weights of Fish caught in River Brora Nets

(Source: Salmon Commission, 1825, 127-135)

Year	Average Weights
1792	8.70 lbs
1793	9.17
1794	8.90
1795	8.14
1796	8.34
1797	8.71
1798	8.62
1799	7.21
1800	6.13

1801	6.25
1802	7.34
1803	7.08
1804	6.43

The catches for 1805 and 1806 were given only in total poundage, otherwise the statistics for the period 1807-1849 (Table 13) follow on directly. The gradual growth of the grilse run from 1799 can be seen at a glance. For the three years 1792-1794 it seems clear from the submitted evidence that the grilse run was not fished at all. Whether this was because financially it was not worth catching fish for salting, or because there were so few grilse, or for a combination of both reasons, is not clear. However, from 1795 the fishing continued throughout the summer but few grilse were caught until 1799. Over the next few years to 1804 the grilse run waxed and waned, symptomatic of a period of change, similarly to the late 1950s and early 1960s (see Section IV).

Findhorn

Findhorn is a medium-sized river on the southern coast of the Moray Firth not far from the Spey. The net catches over the 35 year period 1790-1824, submitted to the 1824-25 Commission by G. Hogarth, are:-

Table 15

Average Annual Weights of Fish caught in River Findhorn Nets

(Source: Salmon Commission, 1825, 94)

Average of Years	Salmon	Grilse
	barrels	barrels
From 1790 to 1800	192.09	24.36
" 1801 to 1812	194.92	50.75
" 1813 to 1824	156.33	77.17

(A barrel was 400 lbs of fish).

There was a decline of salmon and a great increase of grilse.

Catch statistics submitted to the 1902 Commission by Mr. A.P. Hogarth in respect of the Findhorn net catches, or a part of them, provided details of the catches over the decade 1830-39. Annual Average Catches: 2,057 salmon and 4,234 grilse (Salmon Commission, 1902, 523). These proportions of salmon and grilse imply a considerably greater proportion of grilse than in the average annual catch over 1813-1824, assuming the Findhorn early-running stock was largely of the 2SW age group.

Tay

Statistics of the Tay nets catches were not submitted to the 1825 and 1836 Salmon Commissions, or at least they were not reproduced in the available parliamentary records.

Statistics for the period 1788 to 1825 are given by Russel in "The Salmon" (1864) as "an abstract of returns for two fisheries forming in value a half of the whole Tay" :-

Table 16

Numbers of Fish caught in Parts of River Tay Nets

(Source: Russel, 1864, 125)

Annual Averages at 10 Yearly Intervals	Salmon		Grilse	
1788 - 1797	10,874	83%	2,211	17%
1801 - 1810	6,700	73%	2,429	27%
1815 - 1825	11,316	50%	11,220	50%

The particularly low catches for the period 1801-1810 undoubtedly result from the existence in the lower estuary throughout this decade of numerous stake nets. These nets, which were erected in 1799, were declared illegal in 1812, following a lengthy legal action and removed. Neither the earliest nor the latest of the three separate decades of Table 16 are affected by stake-nets catches. Nonetheless, the scale of all the catches appears exceedingly modest for a fishery the size of the Tay, particularly that from 1788-1797, and particularly the grilse catches of this period. One is tempted to wonder whether or not Murdo MacKenzie's observation, in his "View of the Salmon Fishery of Scotland" (1830), might apply: "In Scotland, previous to the last thirty or forty years, the quantity of salmon caught being greater than an immediate market could be found for, they were salted; but the price of salt-fish was then so low as to offer no inducement to over-fishing; so that the rivers kept full of breeding fish, while the aggregate amount sent to market continued nearly the same. It is deserving of notice that, in many rivers, the salmon

fishing used then to be nearly over by the end of May; in some of the late rivers indeed it continued somewhat longer; but the salmon-vats being by this time generally full, the grilses were deemed of so little importance that one-half of them was not destroyed" (MacKenzie, 1830, 6).

There is no way of knowing definitely if the Tay summer run was deliberately underfished in the 1780s and early 1790s. If it were so, both the grilse and the salmon (i.e. the summer run) catches would be understated in a notional comparison with the potential of the fishery. On the other hand, the small numbers of grilse during the 1780s and 1790s recorded for the Tay are similar to the records of other rivers at the same period: Aberdeenshire Dee (Table 6), Findhorn (Table 15), Lochy (Table 23), along with other indications.

Table 16 suggests a constancy of salmon numbers together with a great increase of grilse over a 37 year period. Calderwood (1930) provided the catches for the whole Tay salmon fishery of the lower river and the estuary over the 17 year period 1830-1846 inclusive as given to him by the Earl of Moray. In summarised form these are:-

Table 17
Numbers of Fish caught in River Tay Nets
(Source: Calderwood, 1930, 41-42)

Annual Averages	Salmon		Grilse	
10 Years 1830 - 1839	25,192	36%	45,445	64%
7 Years 1840 - 1846	26,466	38%	42,676	62%

As with many other rivers over the full period of this section, there is a considerable consistency inherent in these averages. The proportion of salmon to grilse was high compared with other rivers, but all the data suggests that the Tay, more so than most other of rivers considered earlier, tends to retain to a greater degree throughout the varying salmon cycles more of the characteristics of a "salmon" than a "grilse" river. In other words, there is a continuing propensity for the total return-migration to consist in greater proportions of 2SW and older stock than for other rivers.

The nets catches at Lord Grey's Kinfauns fishing on the Tay, the most valuable single fishing of the Tay at the period, from 1788 to 1845, were:-

Table 18
Numbers of Fish caught at Kinfauns Fishery of River Tay
(Source: Ashworth, 1868, 65)

10 Yearly Averages	Salmon		Grilse	
1788 - 1797	8,700	(84%)	1,707	(16%)
1801 - 1810	4,667	(74%)	1,617	(26%)
1815 - 1824	9,010	(51%)	8,689	(49%)
1825 - 1834	4,738	(34%)	9,252	(66%)
1836 - 1845	6,733	(38%)	10,931	(62%)

Total catches declined during the period 1801-1810 because of the stake-netting activity durin g 1799-1812 in the lower estuary.

The total catch statistics for the Tay end in 1846 and it was incidentally observed in evidence to the 1902 Committee that the

existing association of lower proprietors terminated in 1846 and that complete statistics for the Tay were not again preserved until the lower proprietors of their day together formed the Tay Salmon Fisheries Company during the 1890s.

4. Contemporary Comment 1800-1850 on the Patterns of the Salmon Runs

A selection of rivers from a wide region has been employed to ascertain the patterns of the salmon runs and their principal variations during c.1790 to 1850.

Since, however, only a selection of rivers has been examined, it is appropriate to record contemporary comment of an embracing nature from authentic sources. In considering the form and wording of this comment importance should be attached to the fact that the divided return-migration of the salmon (used as the generic term) was not then understood and that it was widely believed all salmon had spawned first as grilse. Most of the commentators therefore believed that a decline of salmon was primarily the result of excessive quantities of fish being caught at the grilse stage.

In May 1825 G. Hogarth jnr. of the historically famous firm of Scottish tacksmen (netsmen) of that name gave evidence to the Parliamentary Select Committee on the salmon fisheries. The firm had net fishings on numerous rivers, not all at the same time, including the important rivers Naver, Thurso, Helmsdale, Brora, Shin, Conon, Ness, North Esk, Findhorn, Spey, Dee and Don. Mr. Hogarth provided details of nets' catches for some of these fishings and answered questions put by members of the Committee:-

Q. Has the produce of the rivers with which you are connected increased or decreased of late years?

A. The rivers with which I am connected at present have not decreased in the total weight, although they have decreased in the quantity of salmon produced; but the quantity of grilses has increased so as to compensate for it.

Q. Have you found the decrease of salmon and the increase of grilses to be progressively decreasing and increasing every year?

A. I have; the grilses have been progressively increasing since the year 1790 with some few exceptions; but the returns show that the increase has been gradual from the time that these returns have been made out; there is a gradual increase of the grilses, and a decrease of the salmon, shown in these returns. I may (as corroborating what I have said) observe that it is owing to too close fishing that the size of the salmon has decreased, as well as the number.

(Salmon Commission, 1825, 101)

Murdo MacKenzie (1830) in a tract against stake nets observed:

".....Where the breeding fish are killed, however, the effects are immediately visible in the scarcity of young fish. But it is not here that the decline of the fish is by any means most conspicuous, since the young fish are comparatively plentiful and constitute now, in effect, the staple of the fishery; a proof that the alleged destruction of the breeders is not the principal cause of its decline. It is of grown fish that

there is the greatest scarcity, because from the multiplicity of fishings, and modes of destruction, the salmon are not allowed to attain their full size. Indeed there is hardly a full grown salmon now to be seen, at least not one for a score that were formerly caught, which could only happen from over-fishing. If all the lambs and year-old sheep in the country were killed, would not mutton be scarce? It is the same with salmon." (MacKenzie, 1830, 11)

To the Select Committee of 1836 Mr. James Hogarth, a London fish dealer (no relation to the netting firm of Hogarth), gave evidence.

Q. There is a great increase in the quantity of grilse, compared with the quantity of salmon, of late years?

A. Yes. (Salmon Commission, 1836, S.5885)

In 1843-4 were published two sporting masterpieces. From William Scrope's "Days and Nights of Salmon Fishing in the River Tweed" is noted:

"The salmon of the Tweed are no longer large; far from it. During my experience of twenty years I never caught one there above thirty pounds, and very few above twenty." In the next paragraph, commenting on the salmon run in general: "They come back at first in small quantities, and periodically in the spring and summer months, and in July they arrive in vast quantities....." (Scrope, 1843, 66)

James Wilson F.R.S.E. was a famous biologist and angler. In his "Rod and Gun" we read:

"In relation to the size of the salmon, we may here observe

that Pennant makes mention of one which weighed 74 lbs., and although we now regard, with something akin to wonder, a fish which weighs even the half of that amount, there is no doubt that not many years ago, salmon of 40 pounds were much more frequent than in these degenerate days. The absence of salmon of the largest class from many of our Scotch rivers, where they formerly abounded, is in fact owing to the injudicious perfection of our fisheries, which occasions the constant capture of the species in the state of grilse, or other even earlier condition; and the chances are, by consequence, greatly against any individual escaping the various dangers by which it is environed, for such a succession of years as is likely to admit of its attaining to its full dimensions." (Wilson, 1844, 167)

5. General Conclusions on the Changes in Return-Migration

The statistical and other evidence adduced point, beyond reasonable doubt, to the period under examination opening in the 1790s with a large salmon migration, possibly by the early 1800s already beginning to decline (as a proportion of the total salmon plus grilse run), the proportionate decline becoming obvious from about 1812. The thirty year period 1818-1850 was dominated by heavy grilse runs, the quantities of grilse being in excess of the salmon by varying factors, according to river, of from two to several to one, based on the netting returns.

6. The Timing of the Runs

The main grilse run always takes place in the summer, but in considering the main season or seasons for salmon a critical

attitude towards the sets of statistics submitted to the salmon commissions and published in other source documents is necessary. Many of these sets relate to catches from fisheries so located in estuaries and rivers that they caught fish in large numbers only at certain times of the season, whereas alternative statistics for fisheries on the same river and its estuary, if available, would have presented completely different pictures of the salmon runs and their timing. In view of this, comment in this section is largely restricted to those rivers where adequate detailed or general information is available to yield what is believed to be a true picture of the salmon run as a whole or, at least, the principal seasons. A detailed, or a fairly detailed, analysis is restricted to Dee and Don, plus more general comment on Tay, Tweed and a number of other rivers.

Murdo MacKenzie informed us in 1830 that:

> "Salmon rivers are usually classed as early rivers, and late rivers; and it seems to have puzzled Mr. Kennedy and his Committee (i.e. the Salmon Commission of 1825) exceedingly, to ascertain what occasioned a difference between them. In some early rivers the new fish of the season begin to come on in November and December, and continue to do so till April, when the fishery falls off; while in the late rivers, it is only then it commences." (MacKenzie, 1830, 38)

This statement would be true to some extent at any time but its wording is perhaps particularly redolent of a great salmon period, and it immediately strikes a cord for those familiar, in living experience and memory, with the great salmon era of c.1920-1960.

In considering the earliness or otherwise of the salmon run and its commencement there is a statement submitted by Mr. G.Hogarth to the 1825 Commission showing the produce of various rivers up to the end of March. These rivers all run from the Scottish Highlands into the North Sea on the north-east coast, and include most of the traditionally earliest rivers in Scotland. The seasons of the earliest of these rivers then opened for netting variously from mid-December (e.g. 10th for the Ness and Tay, 12th for Dee and Don). The statement (Salmon Commission, 1825, 100) has been re-cast the more readily to bring out the individual monthly catches by weight: Hogarth promised to submit a further statement covering the remainder of the season by month for these rivers, but this never appeared. An annual average of a ten-year period for each river was given. The ten-year periods are not identical in time but fall variously within the 35 year period 1790-1824. They do, however, provide some indication of the build-up of the salmon run in these rivers. (The Nairn is excluded from the original statement, since it is a much smaller and later river than the others).

(Cont.....)

Table 19

Data for December - March Catches of Salmon

(Source: Salmon Commission, 1825, 100)

RIVER	DEC/JAN.	FEB.	MAR.
	lbs	lbs	lbs
Naver	2,524	2,019	3,374
Thurso	2,285	1,596	3,392
Helmsdale	-	276	3,457
Brora	-	194	2,374
Shin	-	1,011	8,008
Conon	7	461	6,898
Ness	12,167	6,409	6,485
Findhorn	-	33	1,214
Spey	-	2,008	7,632
Don	1,276	2,824	4,965
Dee	1,468	4,066	8,908

In the case of six of the eleven rivers it may be said that the run was hardly under way before March. The Naver and Thurso are quite small north-coast rivers flowing from lochs and it is clear that, in proportion to their volume, they enjoyed a considerable winter run. The Ness was and is a major system of loch and river with a reputation for being among the earliest salmon fisheries in Scotland if not the earliest. There were winter runs in both Dee and Don but even here, having regard to the volume and prolific nature of these two rivers, the subject of subsequent comment, it is clear that the main run was hardly under way before March. These are important distinctions to make for purposes of comparison with the runs of

future periods, and particularly with the great salmon period of the twentieth century (Section III). Of course, fish would be running before March or February in a number of the other rivers listed, but the point is there appeared to be insufficient to make it worth while operating the nets.

The three true winter rivers were Naver, Thurso and Ness. Mr. Hogarth himself observed accordingly when recommending a general opening-date for netting of 1st February:

Q. Do you think that the close time you recommend would be suited to all the rivers in Scotland?

A. I don't say that by any means, but I am of the opinion that a general close time would be the best thing to be adopted, and therefore I am inclined to give and take. There are some rivers which would suffer considerably in not opening before the 1st of February; the Ness for one; the Navir (sic) and the Thurso, all of which, it will be seen by the returns, yield a good deal of fish before that time, and therefore they must suffer.

(Salmon Commission, 1825, 102)

The annual average poundage netted in Helmsdale and Brora before 1st April during the 10 years 1790-1799, nearly all taken during March, related to the annual average poundage of total salmon caught as recorded in Tables 10 and 12 over the 10 year period 1807-1816 - that is before the salmon catch began to decline significantly - appears to demonstrate that many more fish ran from April onwards. In the Helmsdale the ratios were:-

	Up to 31st March	1st April onwards
Helmsdale	3,733 lb (16%)	20,282 lb (84%)
Brora	2,568 lb (15%)	14,065 lb (85%)

In the case of the Brora, it is possible to be more exact in respect of a number of years when the salmon catch was completely separate from the grilse catch over the period 1792-1804: The total salmon catch for these six years (1792, 1793, 1794, 1797, 1798, 1800) is divided by weight:-

Before 1st April:	14,432 lbs (16%)
From 1st April:	76,194 lbs (84%)

(Salmon Commission, 1825, 127-135)

In fact, as may be seen from the monthly catches throughout the period 1792-1804 the main run of salmon in the Brora was from March to June, peaking in April and May.

Documents relating to the Shin, a river of the Dornoch Firth with a rather greater volume than Brora, were submitted together with those for the Brora to the Salmon Commission (1825, 127-135). The Shin salmon run over the years 1792-1804 also peaked numerically in April and May, though with more fish in March.

A fairly exact relationship may be drawn for the Spey from the statistics since there are two overlapping comparable periods available. The average annual netting catch for the ten years 1815-1824 prior to 1st April was 9,640 lbs, nearly 80% of this weight during March. Table 1 demonstrates that the total annual average salmon catch over the 10 years 1810-1819 amounted to 231,152 lbs. The catch before April was therefore nugatory as a proportion of the whole, although the Spey is not a noted winter river.

Mr. Alexander Leslie informed the 1824-1825 Commission of the pattern of the Beauly return-migration from the nets catches (Salmon Commission, 1825, 50) :-

Q. Is the number of clean fish taken in February greater or smaller than the number taken in March?

A. Smaller.

Q. Is the number taken in March greater or smaller than the number taken in April?

A. Smaller.

Q. And in May?

A. In May it is greater than April.

Q. In June?

A. It is scarcer.

Q. In July?

A. It is more plentiful.

The pattern appears to be that the salmon catch increased each month throughout the spring from February, peaking in May. It declined in June and the grilse run came in bulk during July.

Had the members of the 19th century salmon commissions pursued a policy of gathering information for all rivers in the methodical way applied to the Beauly, interpretation of the seasonal patterns of the return-migration would have been vastly easier. Unfortunately they did not, and for many rivers one is compelled to resort to piecemeal partial reconstruction.

Certain information on the patterns of the runs in the Tay is provided by Mr. Robert Buist, the principal witness for this river to the Committee on the Salmon Fisheries Bill 1827 and also to the 1836 Commission. Mr. Buist was managing partner of the principal fishing company in the Tay; this leased fishings in the lower river itself and also in the estuary. It is not always easy to tell which individual

fishery Mr. Buist referred to, but the comments abstracted from his evidence appear to refer to the combined Tay fishings of the company, where not to the Tay as a whole.

Q. Is the fishery very productive immediately after the opening in the beginning of December?

A. In December and January it is not productive; it just a little more than pays the wages.

Q. Does it become more productive during the month of February?

A. It does.

Q. Can you give the Committee any statement which will show what is the average production of the river during those months?

A. I beg to explain, that I speak not only of our own fisheries, but also of all the fisheries of the Tay.

Q. Will you state to the Committee the result of that examination?

A. The value of the fish taken in December and January is £650 upon the average of seven years; and in February the produce is £1,015. But at the same time I may say, that the fish during those months are larger and better in quality than in March and April following the fish fall off in size.

(House of Commons Committee on Salmon Fisheries Bill, 1827, 3)

During an interlude between oral submission by Mr. Buist, a Mr. Henry Groter answered questions:

Q. Do you sell fish for the owners or lessees of the fisheries in the Tay?

A. I do.

(Ibid., 9)

Q. What is the total number in any month in the fishing season you receive, compared with February?

A. We receive more in March than in February.

Q. What do you receive in April?

A. Still more.

Q. Until what month does the quantity go on increasing?

A. June, July and August.

Q. Up to the month of July, the total quantity you receive in season goes on increasing?

A. Yes. (Ibid., 10)

To return to Mr. Buist:

Q. Do the salmon come singly or continually, or in shoals, at different periods?

A. In the early part of the season they seem to come on gradually; but in the principal part of the season, about the months of June, July and August, they come on the coast in large shoals.

Q. Are those which come in April and May comparatively few with respect to the shoals that come afterwards?

A. They are fewer now; about that time (i.e. about 1808) we had the principal fishery in April and May, as the stake nets then did not fish so well (sic).

Q. Which do you consider the great fishing months? - At present June, July and August.

(Ibid., 21)

Mr. Buist to the 1836 Commission:-

A. .....On the 27th of August last we had the best catch of fish during the whole season.

Q. It will depend on the time the flood comes?

A. Yes; the flood was on the 26th of August, and there were a great many killed on the 27th of August; it was the greatest catch of

the season. (Salmon Commission, 1836, S.5428-9)

It appears that a fairly reliable picture of the main runs during 1790-1850 can be constructed, if this oral evidence is taken together with the total catch statistics for the Tay given earlier (pp.27-31). Following a modest winter run of 3SW fish, there was a strong run of 2SW spring fish in April and May during the early part of the period, giving way from the 1820s to a dominant summer fishery substantially of grilse, though seemingly from Tables 16, 17 and 18 with many summer salmon also.

That substantial numbers of summer salmon were running, at least before the great grilse increase, appears to receive support from Mr. Buist's further submissions to the Parliamentary Committee of 1827 on the proposed Salmon Bill:

Q. Will you give us what were caught in each year?

A. I find I have left the book for 1809 at home; I have the other years; the spring fishing for 1810, in the Perth fishings, up to the 1st May, was 316 salmon; the summer fishing 1,859 and 762 grilses; in 1811 the spring fishing was 278, and the summer 1,285 salmon and 364 grilses; in 1812 the spring fishing was 190 and the summer 412, and 1,367 grilses. (House of Commons Committee on Salmon Fisheries Bill, 1827, 22)

There was in 1812 the great increase of grilse so conspicuous in so many other rivers at the same period. The spring catches appear low through the exclusion of May, but clearly the numbers of early spring fish running were modest.

Mr. James Bell, giving evidence to the 1825 Commission, commenting on the weight of Tay fish, observed:- "The Tay fish on the average is

from 12 to 14 lbs weight." This would seem to indicate many 2 + SW summer fish. (Salmon Commission, 1825, 22)

The presence of considerable quantities of summer salmon receives further support from the comment of Mr. J. Johnston, lessee of the estuary and adjacent coastal stake-nets in the North Esk, a prolific salmon river and district in northern Tayside, to the 1836 Commission:-

Q. In what month do you catch most fish?

A. From the middle of July to the end of August, and sometimes there is the greatest number in September.

Q. Do you mean by fish, salmon or grilse?

A. I mean salmon and grilse.

(Salmon Commission, 1836, S.4758-59)

It is a matter of some importance to obtain a picture of the run-patterns in the Tweed during the period, since few other rivers tend to reflect changes in salmon cycles to such an extreme degree, as will become evident later in the thesis. Statistics of catches were provided in 1842 to the Select Committee on the Salmon Fisheries (Scotland) Bill (No. 2) covering some 20 years, but no significant comment on the run patterns accompanied these. Information of a limited kind was provided to the 1825 Commission by way of two letters submitted.

The first of these, dated 16th March 1825, offered information on the early spring catches:

> ".....It (i.e. the fishing in question) commences at the head of Hempside Ford Stream, a little below Kelso, and continues upwards till it reaches the bottom of the Trow Craigs, immediately adjoining the property of Sir Henry Hay McDougal, of Macerstown, a distance of three English miles at least."

(Salmon Commission, 1825, Appendix No. 1, 11)

The location is cited because this fresh-water reach contains perhaps the finest holding pool for early spring fish in Tweed, the Junction Pool (i.e. the junction of Tweed and Teviot) at Kelso, The letter continues:-

".....I beg to leave to acquaint you, that from the commencement of the fishings this year, viz from the 10th January last until 1st of February, I caught 121 salmon and grilse. In this number there were:

Unspawned fish	120
Only One Clean Salmon	1
	121

From 1st February to 1st March current, I caught 44 salmon and grilse; in this number were:

Unspawned fish	25
Kelts	15
Clean Salmon	4
	44

From 1st to 10th March current I caught 17 salmon and grilse; in this number were:

Unspawned fish	7
Kelts	9
Clean Salmon	1
	17

This statement appears to indicate that there were quantities of winter-running spawners in the Tweed but few clean fish, up to the middle of March, at least.

The second, more detailed letter, dated 4th May 1825, was sent by Mr. George Houy to the Commission. Although a lengthy review of

"the present state of the fishings of the river Tweed" it is rather deficient in detailed information on the seasonal runs of fish, but some information is imparted: "The first then in value and importance is the 'clean salmon', by which is meant the salmon in its best state. It makes an appearance about January, though I have seen it so early as the middle of October, and it becomes more plentiful in April and May..... As the season advances and the spawning period approaches, the clean salmon become every day less so, and eventually degenerates into the kipper salmon (the name by which the male) and the baggit salmon (by which the female is distinguished). These terms are applied from the month of August, or thereabouts..... The grilses, or 'gilses' as they are called, make their appearance, according to the season, from the end of June to the middle of July, and are called at first merely grilses; as the season advances, and the spawning time approaches, they receive the same addition as the salmon, and are called baggit gilses and kipper gilses..... Their weight at the beginning of the season is about three or four pounds and it increases as high as eleven pounds....." (Salmon Commission, 1825, Appendix No. 12, 168-171)

From the picture painted by the two letters in 1825, one concludes that the main Tweed salmon run then commenced in April and, by inference, continued throughout the summer. The grilse run started quite late and, by inference and also by virtue of the spread of weights quoted, continued into the autumn. By 1825 the decline of salmon and the increase of grilse was well in hand in Tweed as elsewhere (Table 2), but nowhere was there mentioned, or was it recalled, that the pattern of

the Tweed salmon run had changed in a sense other than that the salmon had declined and the grilse increased. In short, there was no memory of the Tweed having heavy runs of clean fish during the winter and early spring, which is surely relevant when one notes that 1825 is within a few years of the great salmon decline.

That the Tweed was noted primarily as a summer river receives support at the 1825 Commission from the observation of Mr. J.Wilson, giving evidence on the Tweed:-

Q. At what season do you believe that the salmon in general leave the sea and ascend the river for the purpose of reaching the spawning ground?

A. I think they commence leaving the sea about the middle of August; they all try to approach the river at that time. (Salmon Commission, 1825, 13)

And to the same Commission Mr. James Bell gave evidence:-

Q. How much earlier do you suppose the Tay is than the Tweed?

A. The Tweed fish is good in August; that is their best season. They fish till the 10th October in the Tweed. (Ibid., 21)

Of all rivers considered by the 1825 and 1836 Commissions the two, or rather the neighbouring pair, on which most detailed information was submitted as to the patterns of the return-migration were the Dee and Don to the 1825 Commission. They shared not dissimilar patterns of runs except that the Don was a later river than the Dee, as confirmed generally in the response of Mr. G. Hogarth to the Commission:

Q. Do you then consider the time you have mentioned, as that which you call give and take, as to these rivers, upon the whole the best time?

A. Certainly I do. The Don would suffer very considerably by leaving off at that time (i.e. 1st September), because she yields fish late. The Dee will not.....

(Ibid., 103)

Mr. William Stephen, netsman on both Dee and Don, also submitted evidence on these rivers to the Commission:

Q. Do you take as many fish in March as in February?

A. Yes. I have sometimes seen as many clean fish in the month of February as in March, but generally in March they are more numerous than in February.

Q. Is April more or less productive than March?

A. It is more.

Q. And May?

A. It is generally increasing.

Q. And what is it in June?

A. It depends upon the season principally in the river.

Q. And in July?

A. It is still increasing if there be floods in the river.

Q. And in August?

A. It is the most plentiful month of any, and the salmon are in good condition, and also the grilse.

Q. And they continue so till the middle of September?

A. Yes.

(Ibid., 53-54)

As a general picture this description was more apt for the Don than for the Dee, witness both Mr. Hogarth's statement quoted earlier and the statistics of catches by month cited later. Mr. Stephen either intended to bracket the rivers together in a

general statement covering the best seasons in both or he intended to deceive the Commission in order to protect the Dee from the possibility of a mandatory closing date for netting earlier than the then closing date of 20th September. Evidence to the various salmon commissions contains considerable special pleading of this and similar kinds.

In fact, since Mr. Stephen himself submitted details of catches by month in Dee and Don it appears that, in this case, the oral description of the runs was probably intended to be a composite statement covering both rivers.

Mr. Stephen's catch statistics for Dee and Don by month for grilse in 1823 and salmon in 1824 are given in Tables 20 and 21 and include most interesting information on fish weights, to be considered later in this section. The catches were from the Nether Don fishery in the case of the Don, the principal net fishery on that river, and the Raik fishery of the Dee, the principal net fishery on that river:-

Table 20

Dee and Don: Part of Grilse Nets' Catches 1823 (Numbers)

(Source: Salmon Commission, 1825, Appendix No. 14, 335-6)

Months	Don	%	Dee	%
April	12	-	11	-
May	297	1	1,136	4
June	1,308	7	7,812	30
July	7,624	38	12,569	48
August	7,844	39	3,984	15
September (to 20th)	3,112	15	766	3
Totals	20,197	100	26,278	100

The main grilse run was considerably later in the Don than in the Dee, taking place in July and August, as compared to late June and July in the Dee.

Table 21

Dee and Don: Part of Salmon Nets' Catches 1824 (Numbers)

(Source: Salmon Commission, 1825, Appendix No. 14, 336)

Months	Don	%	Dee	%
Dec-Jan.	93	1	29	-
February	217	3	244	2
March	249	3	663	5
April	1,241	17	2,775	22
May	1,202	16	3,380	27
June	1,162	15	2,443	20
July	1,301	17	1,451	12
August	1,321	18	1,181	10
Sept: (to 20th)	733	10	253	2
Totals	7,519	100	12,419	100

The main run of salmon as reflected by these catches began in April in both rivers. In the Dee it was concentrated into the late spring and early summer months and was virtually over by September. The Don main run was constant throughout the netting season from April and clearly continued into the autumn months. From this analysis Mr. Hogarth was correct in stating that the Don yielded considerable fish late but that the Dee did not; and Mr. Stephen's comment that August was the most plentiful month of all is correct as applied to the Don, but not to the Dee where the numerical total run of salmon and grilse was in sharp decline by August.

In respect of the Dee only, Mr. Hogarth filed a comparison of the salmon and grilse catches at the Raik fishery over the seven year period 1786-1792 with the catches of fish during the seven year period 1818-1824, both by weight in lbs:-

Table 22

Weights of Fish caught in Part of River Dee Nets

(Source: Salmon Commission, 1825, 98-99)

Year	Catch to 31st March	April	May	Salmon June-Sept	Grilse
	lbs	lbs	lbs	lbs	lbs
1786	2,340	10,652	27,050	51,356	22,716
1787	9,400	15,460	33,010	127,744	5,094
1788	4,372	7,442	30,954	56,739	18,240
1789	3,414	15,938	35,512	63,636	13,584
1790	17,490	19,382	19,134	82,920	43,958
1791	16,876	23,240	45,466	94,270	29,454
1792	34,068	60,860	78,758	80,694	25,000
	87,960	152,974	269,884	557,539	158,046
1818	1,232	6,202	17,590	71,276	59,064
1819	6,128	13,694	31,038	53,758	76,662
1820	2,864	8,816	20,032	48,122	117,932
1821	8,890	15,674	36,092	74,162	64,154
1822	3,578	16,488	24,784	49,938	47,794
1823	1,361	5,393	18,035	32,113	97,828
1824	7,098	24,205	33,350	60,356	82,810
	31,151	90,472	180,921	389,725	546,244

The summary of these years is:-

Total of Years	Salmon lbs		Grilse lbs	
7 years 1786 - 1792	1,068,357	87%	158,045	13%
7 years 1818 - 1824	692,269	56%	546,244	44%

The full catches year by year have been given because they are of significance. From 1786 to 1789 the salmon run was not substantial (except in the summer of 1787), occurring mainly from May onwards, and the grilse run was quite remarkably small. These statistics tend to support the credibility of the Tay netting returns in the 1780s and 1790s quoted earlier, with their modest quantities of salmon and almost derisory quantities of grilse.

From 1790 to 1792 both the salmon and the grilse runs increased, the spring salmon run substantially so.

During 1818-1824 the salmon run as a whole had returned to the proportions of 1786-1789, but the grilse run had enormously increased.

A common thread throughout the whole of the available Dee catch statistics is that May was usually a big salmon month, proportionate to the total salmon run of the year. Because the summer catches (June to September) are not divided as to month it is not possible to say conclusively that May was more or less consistently the best salmon month, but the May catches were usually considerably greater than the monthly yields obtained by dividing up total catch of the summer months. There must be a degree of probability that the salmon catch did not slump after May but continued at a high level into June, declining thereafter during the summer months, as depicted in the 1824 detailed salmon catches. That this may have been the case

was further confirmed by the response of Mr. Hogarth to the 1825 Commission when undergoing questioning centred round the Dee and the Don:

Q. Do you mean the Committee to believe, that fish in the spring clean from the sea, which cannot by the process of nature spawn for four months afterwards, seek the river with the avidity they would do when ready for spawning?

A. Most certainly I do; and I state one fact in corroboration of it, namely, that during the months of May and June, particularly from the middle of May to the middle of June, there are more salmon caught in the river than at any other season.....

(Ibid., 109)

From an analysis by barrels (each 400 lbs of fish) submitted for the Dee by Mr. Hogarth 1790-1824 annually it can be seen, against the background of the catches for the 1780s, that the great salmon period in the Dee may be said to have extended over a period of 28 years, namely 1790 to 1817 inclusive. Throughout the whole of this period the grilse run, starting from a low level, increased slowly up to 1812 and then more rapidly. (Ibid., 97)

Unfortunately the 1780s catches for the Don are not available. However, the changes in the Don were generally in line with those of the Dee, though the salmon decline was more marked and the pattern of the grilse increase more erratic. But clearly the great salmon period may be deemed to have terminated with the year 1817 and the great grilse period to have commenced in 1812. (Ibid., 96)

The comparative shortage of grilse during the 1780s and 1790s noted in several rivers earlier seems evident in the records of the principal net fishing on the river Lochy:-

Table 23

Numbers of Fish caught in River Lochy Nets'

(Source: Annual Report of the Fishery Board for Scotland, 1883, 147)

Year	Salmon	Grilse
1785	3,678	976
1786	2,036	3,899
1787	5,279	819
1788	1,498	2,032
1789	1,260	835
1790	1,041	830
1791	576	1,200
	15,368	10,591
Annual Average	2,195	1,513

Only for the Dee (Yable 22), the Tay (Tables 16 and 18) and the Lochy (Table 23) does there exist any statistical information back into the 1780s testifying to the dominance of salmon over grilse in the major rivers; also to the apparently modest levels of runs and catches; and for the Dee alone the comparative shortage of winter and early spring-running fish in a river traditionally famous for its runs of such fish. However, a letter of January, 1788, from Tweedside specifically comments on the poor catches prior to 1787 in the Tweed net fisheries, and on the improved catch of the 1787 season (the season in which there was a big summer salmon catch in the Dee: Table 22). The letter reads: "Jan. 1788: For some years past the Tweed fisheries have been thought to be on the decline, but

this last season has lighted up joy and cheerfulness on the banks of the Tweed.... May not the bad seasons we have formerly had be attributed to the injuries the river has sustained in the winter?" (i.e. injuries caused to the spawn by the exceptionally inclement and cold winters of the 1780s.)

The very high price, and therefore the scarcity, of clean fish at the beginning of the season is also made clear in the letter:

> "As to the price of salmon at the river side; in the beginning of the season they (sic) are very high; a good sound fish (for some at this time are not so) will fetch 1/=, 1s.3d, and 1s.6d per pound: if a vessel is ready to sail for London, with a fair wind, for everything here points to the metropolis, the buyer will speculate very high, and even advance upon 1s.6d.
> Most of the time that salmon is sent fresh away, the prices are from 9s. down to 5s. per stone, dependent on the prospects of a fair wind for London, and the plenty of fish caught.
> When the hot season comes in, and salmon can no longer be sent fresh up to town, and even pickled salmon is less in request there, we have it here sold for 12d, 10d and 8d per stone, which is less than one halfpenny per pound, as a stone of salmon is 18 lb 10½ oz avoirdupois...." (The Fishing Gazette, 1916, 257)

7. General Conclusions on the Timing of the Runs

The evidence indicates that the numbers of winter-running non-gravid fish throughout the period c.1790-1850 were modest. Even during the great salmon period of c.1790 to c.1820 only the Ness, Thurso, Naver and Tay possessed clean winter fish in sufficient quantities for it to be economically worthwhile working the nets. The Naver and Thurso shared a common district

and the earliness of the "spring" run may have resulted from geophysical characteristics based both on their far northern locality and their origins in lochs. The two rivers were noted at other periods for their early-running fish. The Ness was and remained a genuine winter and early-spring river. There is no evidence for the period 1790-1850 that the winter and spring run of the Ness was the sole run of the headwater river and system of Glengarry and Glenquoich, but it was recognised in later times that this was the genuine run of the upper Ness, with summer salmon and grilse rarely penetrating the rivers and lochs of this upper system.

The contention that these four rivers were the main representatives at the period of the class of river yielding winter clean fish in significant numbers (proportionate to their respective volumes) rests on the earlier examples of many major east-coast rivers.

Excluding these special rivers there is sufficient evidence to justify the claim that, in general, clean salmon in Scotland during the period under review began to run in quantity during the month of March, or in some rivers - some of them big rivers - not until April. The northerly rivers of any volume were mainly earlier rivers: in Brora, Shin, Dee, Beauly, of those examined in any detail, the salmon run tended to peak variously during April to June. Further south the start of the main runs tended to be delayed until April and to continue, on the available evidence, throughout the season into the later summer or autumn: Tweed, Don, North Esk, the 2SW stock in the Tay. This trend analysis is regionally significant. The Don-Dee contrast is rather anomalous and there are a number of other similar cases. Something has to be allowed for river types, their geophysical characteristics, innate properties and other factors known and unknown.

Some considerable emphasis has been laid in this chapter on establishing both the start and the development of the Scottish salmon run, and this emphasis is not fortuitous. On the conclusions reached here depends subsequent conclusions drawn about characteristics of later class-age cycles in relation to the cycles occurring during c.1790 to 1850 (and particularly in relation to the great salmon period of c.1790 - c.1817).

This evidence, independently adduced, tends to support Sir Humphry Davy's submission on the general nature of the total salmon (i.e. salmon and grilse) migration to the 1825 Commission:

> "Salmon begin to run up rivers generally in March, and continue migrating from the sea till October or November; but in the early spring, there are few in motion. In June and July they migrate in great number, and so in August and September, but this depends upon the seasons, and particularly the quantity of water in the river; the large fish seldom leave, except in floods, unless late in the year, and the one year old fish are almost always most abundant in large rivers in July...."
> (Ibid., Appendix No. 3, 144)

It should be borne in mind that, at the date of Sir Humphry's submission, the salmon run had been in general decline for a number of years and, perhaps more significantly, that the grilse run (at least in Scotland) had been rapidly changing for over ten years. Sir Humphry, who was both a famous scientist and a famous salmon angler, had by 1824 a long experience of British rivers, perhaps, above all, of Scottish rivers, as is quite clear from his book "Salmonia" of 1828, (especially the fifth chapter).

Davy also recommended that: "No angling should be allowed in

salmon rivers till May..." (Ibid., App. No. 3, 145) This apparently extreme blanket proposition was in part propounded with a view to protecting spent fish and migrating smolts, but it tends indirectly to bring into focus the development of the salmon migration, since Davy would hardly have been led into such a recommendation at the expense of a principal season for clean fish.

In his volume of 1824, "A View of the Present State of the Salmon and Channel-Fisheries", which discusses in its various chapters many English and Scottish salmon rivers, Cornish entirely supported Davy's general description of the salmon run:

> "I have already briefly observed that the season for taking salmon ought to be the six summer months commencing with April and ending with September; that they do not make a very frequent appearance in our rivers early in the year, and that therefore new fish are then always scarce and dear. In April, after having had the advantage of feeding in the sea, they begin to be rich and fat, and return to the rivers. They so continue the whole summer, increasing as it advances, rising with the flow of the tide, and particularly attracted with the freshets after heavy rains. This is the time, namely the six summer months, and the only time that they should be caught, and then only with the legal net." (Cornish, 1824, 24).

As to the grilse run specifically, there are no observations on the 1790-1850 period that need making at this stage that will not the more significantly be made in later sections by way of comparison. The main grilse run always takes place within the summer and early autumn months, from June to September. It does from time to time vary significantly in its commencement and

duration within these four months. There are also significant variations in the mean weights of grilse.

8. Salmon and Grilse Weights

There are too few statistics to justify a thoroughgoing analysis of fish weights and their changes during c.1790-1850. For most rivers, including many of those discussed in earlier sections, there are no weights given. Nonetheless, some information is available for some of the rivers considered earlier and also in regard to one or two others. The most detailed information on weights was provided for Dee and Don by the netsman Hogarth in his submission to the 1825 Commission, covering the 35 years 1790 to 1824, in the form of averages for 11-12 year intervals:-

Table 24
Average Weights of Fish in River Dee
(Source: Salmon Commission, 1825, 93-97)

Dee	Salmon	Grilse
1790 - 1800	12.06 lbs	3.74 lbs
1801 - 1812	10.53 lbs	3.74 lbs
1813 - 1824	10.00 lbs	3.74 lbs

Table 25
Average Weights of Fish in River Don
(Source: Salmon Commission, 1825, 93-97)

Don	Salmon	Grilse
1790 - 1800	12.77 lbs	4.26 lbs
1801 - 1812	11.27 lbs	4.26 lbs
1813 - 1824	10.74 lbs	4.26 lbs

As regards the salmon weights there was, during the 35 years, either a progressive decline in the remainder of 3SW fish; or the 2SW fish declined in average weight; or more fish ran in the spring than the summer; or a combination of one or more of these factors. The grilse weights are remarkably consistent, suspiciously so, and one wonders if the numbers of grilse may have been arrived at by dividing known total weight figures by approximate average weights of grilse measured for part of the full period of time.

The average weights from the detailed monthly catches for 1823-1824 submitted in Tables 20 and 21 are:-

Dee:	Salmon	10.26 lbs
	Grilse	3.75 lbs
Don:	Salmon	11.23 lbs
	Grilse	4.86 lbs

Certainly the trend of the 35 year figures appear to be validated by this single year's detailed averages: Both salmon and grilse in Don were heavier than in Dee, and the low weight of the Dee grilse particularly is supported. The grilse weights over the 35 year period were low in both rivers, though Dee has been noted for the exceptional smallness of its grilse at other periods (see 1872-1950 analysis later).

That the salmon weights particularly in Dee and Don were light by the standards of the later 19th and the 20th centuries is evidenced by the following table of salmon and grilse average weights by month relating to the numbers of grilse caught in 1823 and of salmon in 1824 in the Dee and Don given in Tables 20 and 21 respectively.

Table 26

Average Weights of Fish in River Dee

(Source: Salmon Commission, 1825, App. 14, 335-6)

Dee (Raik Fishery)	Av. Weights in lb.	
	1823: Grilse	1824: Salmon
Dec/January	-	6.0
February	-	7.0
March	-	8.0
April	2.0	8.9
May	2.2	9.9
June	2.8	10.7
July	3.8	11.7
August	5.0	12.8
Sept. (to 20th)	5.1	13.2
Av. of total catch	3.75	10.26

Table 27

Average Weight of Fish in River Don

(Source: Salmon Commission, 1825, ibid.)

Don (Nether Don Fishery)	Av. weight in lb.	
	1823: Grilse	1824: Salmon
Dec/January	-	7.4
February	-	7.5
March	-	7.9
April	2.0	8.7
May	2.4	9.7
June	3.1	10.7

July	4.2	12.5
August	5.4	13.9
Sept. (to 20th)	5.9	13.8
Av. of total catch	4.86	11.23

The salmon and grilse average weights were also low in the Ewe of Loch Maree in 1806:-

Table 28

Average Weights of Fish in River Ewe in 1806

(Source: Annual Report of the Fishery Board for Scotland, 1884, 129-30)

	Salmon	
Month	No.	Av. weight
February	9	
March	71	
April	99	
May	144	
June	189	
July	113	
August	58	
	683 = 5,990 lb. =	8.77 lb. each

1,412 grilse were caught weighing 5,076 lb.= 3.59 lb. each

It is surely significant that oral evidence submitted by Mr. W. Hogarth about the Spey to the 1836 Commission tends to lend credibility to the declining and low salmon weights in Dee, Don and Ewe:-

Q. Can you give us the average weight of the fish in any fishing, during a succession of years, tending to show a decrease?

A. Yes. On the river Spey, on an average of years, from 1774 to 1782 the average weight of the whole season of salmon was 12.75 lbs; from the years 1804 to 1814 the average weight was 10.7 lbs; from the year 1814 to the year 1823 it was 10.6 lbs; but the decrease in size is most remarkable in salmon caught before the 1st May in the same river; in 1774 fish caught before the 1st May averaged 17.5 lbs; in 1778 they averaged 13.5 lbs; from 1804 to 1813, on an average, the weight was 9.4 lbs; from 1814 to 1823 it was 8.8 lbs; and every river in Scotland will show the same decrease.

Q. Is that salmon or grilses?

A. It is salmon.

Q. The result is that the weight and number of salmon has decreased and the grilses have increased?

A. Yes.

(Salmon Commission, 1836, S.1612-4)

The last question and reply appear to have been true for the early years of the 19th century in Spey and in Dee and Don, but there is inadequate information to establish the position during the last quarter of the 18th century, particularly 1774-1790. Indications from the rivers Dee, Tay and Tweed are that the great salmon increase did not get under way until 1787-1790. The average weight of 17.5 lbs for Spey spring fish before 1st May in 1774 may indicate a great preponderance of 3SW fish at that date and a subsequent movement to 2SW spring fish. On the other hand, it may be the aberration of a single year due, perhaps, to climatic factors such as a late winter

delaying the run (the 18th century winters were often very cold), so that only the vanguard of the spring run, which in many rivers consists of 3SW fish, had arrived by April. Alternatively, the 2SW fish may simply have been summer-running at that date, becoming earlier with the increase of the run (as in the Dee 1786-1792).

That the Commissioner's question - "the weight and number of salmon has decreased and the grilses have increased?" - was generally true by 1836, when it was put, as regards numbers has already been shown in earlier sections. As regards weights, submissions in respect of Dee, Don and Spey receive support from the trend in the Shin. The average weights by month, for salmon only, in respect of the three years 1792-1794 were:

Table 29
Average Weight of River Shin Salmon 1792-94
(Source: Salmon Commission, 1825, 126-35)

February	22.36 lb
March	22.59 lb
April	19.68 lb
May	14.52 lb
June	13.46 lb
Av. Wt. overall	18.65 lb

There was obviously a fine run of 3SW spring fish in this river partly extending into the later spring months. Only the salmon run was netted; no grilse are recorded for these three years. Yet the nets' catches for the three years 1833-1835 present a completely different picture, with an average weight for total salmon (as opposed to grilse) of only 11.39 lbs.(Salmon Commission, 1836, App. No. 1, 322)

The grilse weights for Shin were 4.65 lbs at the turn of the century, being the average of 1797 and 1800, the sole two early years for which individual grilse weights can be identified, and 4.63 lbs as the average of 1833-35. There is no significant observation to be made about the comparative grilse weights, but the run of spring 3SW fish had obviously gone into marked decline between 1794 and 1833, the residual salmon stock consisting, by 1833-35, largely of 2SW fish. (There may be a legitimate analogy between the decline of the Shin run of big spring fish, following the decline of the salmon run generally coincident with a great increase of grilse, and exactly the same changes recently, since the 1950s up to 1976, in the Scottish return-migration generally).

However, the declining trend of the weights in all these rivers was not shared by Brora and Helmsdale, although periods for which data are available are not identical and this could conceivably be significant. Furthermore, throughout the period for which statistics are available on these two rivers, that is, much of 1792-1835, during a rapidly changing cycle, it is clear from all the weights that the salmon stock throughout this period was very substantially of 2SW fish. For other rivers considered, average salmon weight was definitely influenced in some instances by 3SW fish, and other rivers may have been so influenced. This may have a bearing on the comparison of salmon average weights in Brora-Helmsdale with other rivers during the period.

(Contd.....)

Table 30

Average Weight of Fish in River Brora

(Sources: Salmon Commission, 1825, 126-35;
Salmon Commission, 1836, App. No. 1, 322)

Average of Years	Salmon	Grilse
1792-94	8.86 lbs	-
1797-1800	-	4.28 lbs
1807-17	9.59 lbs	4.37 lbs
1821-30	9.83 lbs	4.68 lbs
1831-35	8.72 lbs	4.54 lbs

The average monthly weights in Brora over 1792-94 were:

Table 31

Average Weight of Salmon in River Brora

(Source: Salmon Commission, 1825, 126-35)

Jan-Feb	8.42 lb
March	8.51 lb
April	7.40 lb
May	9.22 lb
June	11.15 lb
July	12.25 lb
Av. Wt. overall	8.86 lb

The January, February and March average weights of Table 31 were influenced by 3SW fish; the April run consisting entirely or almost entirely of 2SW fish. In May the 2 + SW summer fish began to run. The grilse weights were low and generally follow in line with

the salmon weights, which were also low. The average grilse weight for 1797-1800 actually covers the years 1797, 1798 and 1800 only: these are the only years from the period for which the grilse weights can be identified.

The Helmsdale average weights were:-

Table 32
Average Weights of Fish in River Helmsdale
(Source: Salmon Commission, 1825, App. No. 1, 323)

Helmsdale	Salmon	Grilse
1807-17	9.55 lbs	4.32 lbs
1821-30	9.65 lbs	4.57 lbs
1831-35	9.73 lbs	4.82 lbs

Both salmon and grilse weights were rather low; the grilse followed the pattern of the salmon weights to a degree, proportionate to weights. After having much in common with Brora there was a marked divergence during 1831-35, the Brora salmon and grilse weights declining, as compared with 1821-30, and the Helmsdale weights for both fish increasing.

Weights are available for three other north coast rivers not previously mentioned in detail. The Naver and Borgie catches and weights were combined. Naver was a famous salmon and grilse river of the smaller type, and has remained so to the present day. Borgie is a neighbouring smaller river of similar type. For the years 1830-1835 inclusive the average weight of the salmon was 10.18 lbs and the grilse 5.23 lbs. For the Hope, a small north coast summer river, the average weights over 1825-1835 inclusive were 11.19 lbs for salmon

and 5.33 lbs for grilse. (Ibid., App. No. 1, 323)

Despite the paucity of information there appear to be some general trends:

1. Salmon (2SW) and grilse average weights were low in many rivers in the early decades of the nineteenth century.
2. There may have existed a tendency for the 2SW salmon average weight to increase by the 1830s and 1840s, possibly associated with a movement of the salmon run towards the summer months as it declined during the grilse cycle (see also Table 58, Section II).
3. As the salmon run numerically declined the residual stock of 3SW fish correspondingly declined, according to the experience of the Shin and reportage about a general decline of heavy fish.
4. As the grilse increased in number they tended to increase in average weight.

These weights, limited though they are in range, are of some importance for the purposes of comparison with weights of fish at later periods.

It is unfortunate that weights are not available for one or two of the more southerly rivers where, as previously argued, indications are that more of the salmon at the period ran during the summer months. Data, particularly from Tay and Tweed, would have created another dimension and would have been particularly useful for comparison with subsequent periods. No river suffers such extreme variations in return-migration patterns and in weights during various cycles as Tweed later in the 19th century and during the 20th century.

CYCLICAL VARIATIONS IN THE RETURN

MIGRATION OF SCOTTISH SALMON

BY SEA-AGE

c. 1790 TO 1976

SECTION II: 1851 - 1900

Section II

Chapter Headings

1. Introduction

The patterns of the salmon return migration in Scotland during the period 1851-1900 are more complex to decipher than the variations occurring c.1790-1850 outlined in the first section. This is primarily because the runs of the earlier period took place substantially within the dates of the official netting season, notwithstanding some variations in the latter from district to district. The nets in most of the major rivers began working then as early as December or January but, with a handful of exceptions, their returns were modest before February or March, usually the latter month. At the end of the season netting in some rivers continued into September or October, but even on major rivers with big late summer runs, such as Tweed, Tay and Don, the runs were generally reported as peaking in July or August, declining thereafter. The consequence of these habits was that the official net catch statistics for that period could be employed to provide a legitimate review of the return migration of salmon and grilse and its variations throughout the sixty years 1790-1850.

By contrast, from the later 1850s, as will be argued in this section, a much greater degree of activity began to take place both before the netting season started and after it had closed, particularly the latter. The result of this development is that the netting records for 1851-1900 cover only a part of the return migration, and it is consequently

necessary to resort to other evidence, including details of rod catches before and after the netting seasons, the reportage of netsmen and sporting commentators, together with an analysis of fish weights and their implications. The difficulties associated with making sense of the official nets catches are compounded by the changes in the durations of the netting seasons in various rivers, resulting from the Scottish and Tweed Salmon Acts of the 1850s and the 1860s, just as the runs themselves began to change significantly in their patterns.

The great grilse period that started in the early years of the century - indeed that started from an extremely low ebb in the run of this class of fish in the 1780s - and that dominated the three decades from 1820, went into an immediate and remarkable decline in the 1850 season. The decline of a great grilse cycle may leave, though not necessarily to a consistent degree, the total return migration numerically substantially reduced, without a corresponding compensation from any other age-class for a time, and such was the general picture in the early 1850s, as will be demonstrated. It is argued in this section that the grilse were replaced from the 1850s and the 1860s by an increased salmon run, but that this feature is not particularly or necessarily very obvious from the netting statistics of numerical catches, for reasons outlined in due course.

There are other reasons why the nets catches by themselves are inadequate to yield a true reflection of the total return migration over the fifty years. One reason is that there are fewer good sets of statistics than were produced for the Salmon Commissions of 1825 and 1836, and in other early literature. Partly this resulted from

the growing secrecy of net fishery proprietors and lessees, which stemmed from the open hostility existing between coastal fixed netters, estuary and lower river netters and riparian landowners seeking revenues from the rapidly growing sport of salmon angling. But it resulted also, to a considerable degree, from the deficiencies of two out of the three general Salmon Commissions or Enquiries established to investigate the Scottish salmon run or aspects of it during the fifty year period. There was a relative absence of sound statistical information and this deficiency resulted from the terms of reference of the two Commissions and the single Enquiry.

The 1860 Commission was in fact, a Select Committee of the House of Lords, established by and consisting of a group of major Scottish landowners and their sympathisers, such as the Duke of Richmond and Gordon (Spey) and Lord Lovat (Beauly), who were by 1860 losing substantial revenues, or so they with some justification believed, through the decline of their river and estuary net-fishings to the corresponding benefit of the expanding coastal fixed-net fishings. It is clear from a reading of the 1860 Commission minutes, from the kind of witnesses called and from the form of interrogation to which they were subjected, that their Lordships were motivated by a preconceived intention to pass a resolution at the termination of their hearings declaring that the fixed coastal nets should be made illegal. Such a resolution was duly passed, but it never became law. The result of this partial enquiry was a paucity of impartial statistical information.

Notwithstanding the partiality of the Commission members, there is no doubt at all that by the 1850s the catches of the coastal fixed

nets had increased substantially at the expense of the river and estuary net fisheries, over the preceding thirty years and more. Such was admitted without demur to the Commission by numerous witnesses operating fixed nets. One netsman of the Kincardineshire coast, asked whether there were more bag net fishings in his locality than there used to be, replied that bag nets had always been increasing in number since he had started in 1835. (Salmon Commission, 1860, S.3017). A tacksman with river netting rights was asked if he was giving lower rents than formerly, and he answered that some of the river rents had "diminished prodigiously" at the same time the coastal net fishing rentals had increased. (ibid., S.465). The growth of the salmon fishing industry in general was encouraged by the rapid development of the railway system throughout Britain after 1830. This enabled the supply of fresh salmon at good prices to wealthy southern markets to be made much easier than by the sailing ships which were used before the railway came into existence along the Scottish east coast as far north as Inverness.

The 1871 Enquiry was established to report on the efficacy or otherwise of the Scottish salmon legislation of the 1860s. As a member of committee undertaking the Enquiry, Frank Buckland, Inspector of Salmon Fisheries for England and Wales, devised a questionnaire that was distributed to a large number of proprietors and lessees in Scotland. The purpose of the questionnaire was to make it easier for the correspondents to formulate meaningful responses, but in the event most of the latter were statistically meaningless where not calculatingly devious. Some of this comment is useful, however.

The Elgin Commission sitting during 1900-1902 was more like the

old commissions of the early part of the century both in approach and content. The Minutes contain some useful statistics and comment, though without the degree of openness that characterised the 1825 Commission. An unworthy desire to preserve at almost any price the integrity of their catch records motivated even the most distinguished of witnesses. The Duke of Richmond and Gordon permitted his witness to provide the Spey net catches covering the period 1858 to 1900 only as percentages above or below the average, but he omitted to supply the key base figure necessary to render the percentages meaningful.

2. Catches in Rivers, Estuaries and Coastal Fisheries by Net, and in Rivers only by Rod

The fisheries for which statistics are provided, covering the fifty year period in whole or in part, are in prolific east-coast rivers or districts either of the first class or of good quality, extending over a variety of different geographical regions between Caithness and the Borders: including Tweed, Tay, Aberdeenshire Dee, Spey, Findhorn, Beauly, Brora, Helmsdale and Thurso. The implications of the statistics have had to be interpreted, in a later chapter on the timing of the runs, to a greater extent than was necessary in section one covering c.1790-1850.

(i) Billingsgate Market Returns of Scottish Salmon together with Prices, 1834-1859

The great and immediate decline of the Scottish grilse from 1850 can be shown by a comparison of the quantities of net-caught grilse given later in this section with the quantities of grilse given in the first section.

The immediacy of the grilse decline and its overall

effect on the supply of salmon to market can be seen in Table 33 detailing the number of boxes (112 lbs each) of Scottish salmon sent to Billingsgate in each year during the period 1834-1859 inclusive, together with average price per lb for each year. A substantial reduction in the number of boxes returned is manifest for the year 1850, and the other returns during the 1850s as a whole were markedly less than those for the 1840s. The shortage of salmon from Scotland at Billingsgate in 1850 was at once reflected in an increase in average price per lb from 7½d in 1849 to 1/0⅞d in 1850.

Table 33

Number of Boxes of Scottish Salmon of 112 lb each sent to Billingsgate Market, London 1834 - 1859

(Source: Salmon Commission, 1860, S.1968)

Year	No. of Boxes	Av. Price per lb	Year	No. of Boxes	Av. Price per lb
		s. d.			s. d.
1834	30,650	- 9½	1847	20,112	- 9¼
1835	42,330	- 9	1848	22,525	- 8⅞
1836	24,570	- 10½	1849	23,690	- 7½
1837	32,300	- 10	1850	13,940	1 -⅛
1838	21,400	- 10½	1851	11,593	1 -½
1839	16,340	- 11	1852	13,044	- 11
1840	15,160	- 11	1853	19,485	- 10
1841	28,500	- 8¾	1854	23,194	- 9¼
1842	39,410	- 7⅛	1855	18,197	- 11⅜
1843	30,300	- 7¼	1856	15,438	1 -⅛
1844	28,178	- 7½	1857	18,654	- 11⅛

1845	31,062	- 7½	1858	21,564	- 10½
1846	25,510	- 8⅝	1859	15,823	1 -⅞

Note:- (a) These Billingsgate returns included fish caught in both estuary and coastal fisheries and are therefore believed to be an accurate reflection of catches from all the various sources.

(b) Not all returns to Billingsgate were in the form of 112 lb boxes. To allow comparison, all returns are expressed as boxes of 112 lbs. (ibid., S.424)

(ii)

Table 34

Numbers of Boxes of Scottish Salmon of 112 lb each sent to Billingsgate Market, London 1860 - 1900

(Source: Annual Report of the Fishery Board for Scotland, 1900, ix)

Year	No. of Boxes	Year	No. of Boxes
1860	15,870	1880	17,457
1861	12,337	1881	23,905
1862	22,796	1882	22,968
1863	24,297	1883	35,506
1864	22,603	1884	27,219
1865	19,009	1885	30,362
1866	21,725	1886	23,407
1867	23,006	1887	26,907
1868	28,020	1888	22,857
1869	20,474	1889	21,101
1870	20,648	1890	18,931
1871	23,390	1891	25,889
1872	24,404	1892	21,919

1873	30,181	1893	18,903
1874	32,180	1894	15,489
1875	20,375	1895	25,364
1876	34,655	1896	22,435
1877	28,189	1897	16,284
1878	26,465	1898	14,174
1879	13,929	1899	15,411
		1900	15,151

From Tables 33 and 34 can be seen that the decline in catches and returns to Billingsgate that began in 1850 continued until 1862, from which year there was a sustained increase in catches and returns (as weights) to market. It will be necessary later to identify the main class or classes of fish constituting these enhanced catches by weight. Apart from the fact that the individual river catch statistics do not indicate a revitalised grilse run - rather the contrary - during the 1860s, the salmon catch statistics do, by themselves, give only limited information. However, there is clearly recorded in the overall statistics an increase of the grilse run that took place in most rivers during the period 1881-1896 inclusive.

(iii) Tweed

(See next page)

(a)

Table 35

Numbers of Fish Caught in River Tweed Nets

(Source: Annual Report of the Fishery Board for Scotland, 1889, Appendices, 42)

5 Yearly Averages	Salmon	%	Grilse	%	Totals
1850 - 54	9,723	26	27,887	74	37,610
1855 - 59	9,915	27	26,408	73	36,323
1860 - 64	8,364	27	22,786	73	31,150
1865 - 69	8,931	37	15,015	63	23,946
1870 - 74	11,253	40	16,623	60	27,876
1875 - 79	9,270	41	13,165	59	22,435
1880 - 84	10,841	44	13,832	56	24,673

(b)

Table 36

Catches of the Netting Stations of The Berwick Salmon Fisheries Co. in the Tweed

(Source: Salmon Commission, 1902, S.14705)

5 Yearly Averages	Salmon	%	Grilse	%	Totals
1860 - 64	6,131	29	15,118	71	21,249
1865 - 69	6,214	39	9,681	61	15,895
1870 - 74	8,266	44	10,603	56	18,869
1875 - 79	5,733	44	7,341	56	13,074
1880 - 84	7,262	46	8,427	54	15,689
1885 - 89	7,267	44	9,359	56	16,626
1890 - 94	6,440	46	7,432	54	13,872
1895 - 99	7,366	47	8,458	53	15,824

(c)

Table 37

Some Coastal Nets Catches of The Tweed District

(Source: Salmon Commission, 1902, Appendix 17, 27)

5 Yearly Averages	Salmon	%	Grilse	%	Totals
1845 - 49	3,151	24	9,994	76	13,145
1850 - 54	3,080	36	5,517	64	8,597
1855 - 59	4,011	44	5,505	58	9,516
1860 - 64	2,944	32	6,309	68	9,253
1865 - 69	3,969	49	4,135	51	8,104
1870 - 74	5,239	49	5,494	51	10,733

The varying periods are covered by three sets of statistics:

(a) 1850-1884; (b) 1860-1899; (c) 1845-1874 only; all in quinquennial averages.

Taking the combined sets as a whole there was a tendency for grilse to decline and salmon to increase as proportions of the total catches during the progression of the fifty years period. There was also a tendency for the numbers of grilse to decline, at least during the thirty years 1850-1879, and, somewhat vaguer, for the numbers of salmon to increase. The increase of grilse so conspicuous in the catch figures of most rivers 1881-1896 is not marked in the Tweed averages.

(iv) Findhorn

(a)

Table 38

Lower River-Estuary Nets Catches in the Findhorn

(Source: Salmon Commission, 1902, S.15298)

10 Yearly Averages	Salmon	%	Grilse	%	Totals
1860 - 69	1,884	42	2,634	58	4,518
1870 - 79	2,410	50	2,430	50	4,840
1880 - 89	2,464	41	3,504	59	5,968
1890 - 99	1,897	50	1,917	50	3,814

(b)

Table 39

Some Coastal Nets Catches of the Findhorn District

(Source: British Industries: Salmon Fisheries, 1877, 276-7)

Averages of Years	Salmon	%	Grilse	%	Totals
1856-59 (4 yrs.)	2,173	46	2,584	54	4,757
1860-69 (10 yrs.)	1,809	45	2,242	55	4,051

No catches are available for 1850-55. The decade of the 1870s witnessed improved salmon catches in comparison with the average of the 1860s. There was a strong increase of the grilse during the 1880s, followed by a much reduced grilse run in the 1890s. Catches by individual year were not recorded in the Commission minutes, but the reduction in grilse 1890-1899 almost certainly would have reflected, by analogy with events generally, a strong decline during the four years 1896-1899. The salmon catch too declined during the 1890s.

(v) Brora

Table 40

Nets Catches in the River Brora

(Source: Salmon Commission, 1902, Appendix 24, 54)

5 Yearly Averages	Salmon	%	Grilse	%	Totals
1864-69 (6 yrs.)	440	33	908	67	1,348
1870-74	776	36	1,360	64	2,136
1875-79	855	44	1,100	56	1,955
1880-84	1,134	48	1,215	52	2,349
1885-89	1,250	47	1,386	53	2,636
1890-94	1,315	55	1,079	45	2,394
1895-99	1,511	53	1,356	47	2,867

(vi) Helmsdale

Table 41

Nets Catches in the River Helmsdale

(Source: Salmon Commission, 1902, Appendix 24, 52)

5 Yearly Averages	Salmon	%	Grilse	%	Totals
1864-69 (6 yrs.)	465	31	1,054	69	1,519
1870-74	578	23	1,906	77	2,484
1875-79	643	28	1,651	72	2,294
1880-84	854	28	2,169	72	3,023
1885-89	738	22	2,676	78	3,414
1890-94	957	37	1,633	63	2,590
1895-99	1,418	38	2,323	62	3,741

The significantly increased catches of both salmon and grilse in Brora and Helmsdale during the period 1895-99 owed much to the start of bag-net fishing on the coasts adjacent to the two rivers in 1896, the catches from the bag nets being included with the estuary nets catch returns. Despite this, there is a remarkable progressive increase of salmon and grilse in the catches during the 36 year period for which records exist. Circumstantial evidence exists to the effect that from 1876 the netting did not commence until 1st May, which adds a further dimension. The implications of the catches are discussed in detail later.

(vii) Beauly

Table 42

Nets Catches in the River Beauly

(Source: British Industries: Salmon Fisheries, 1877, 279)
(Source: Salmon Commission, 1902, S.14315)

5 Yearly Averages	Salmon	%	Grilse	%	Totals
1856-60	1,160	24	3,671	76	4,831
1861-65	1,006	20	3,909	80	4,915
1866-69 (4 yrs.)	1,239	25	3,820	75	5,059
1875-79	1,585	28	3,995	72	5,580
1880-84	1,454	31	3,294	69	4,748
1885-89	914	18	4,246	82	5,160
1890-94	491	20	1,998	80	2,489
1895-99	146	15	842	85	988

After the 1892 season the netting was reduced to two days a week; hence the considerable decline of catches during the last two quinquennial periods. There was the same increase of salmon in the 1870s common to other rivers, and a similar increase of grilse during a part of the 1880s. From 1887 there was a marked decline in the salmon run. Events in this river are discussed in greater detail subsequently.

(viii) Aberdeenshire Dee

Table 43

Nets Catches in the River Dee

(Source: Annual Report of the Fisheries Board for Scotland, 1896, X)
(Source: Records of Aberdeen Harbour Commissioners)

5 Yearly Averages	Salmon	%	Grilse	%	Totals
1872 - 76	5,023	43	6,649	57	11,672
1877 - 81	4,935	41	7,036	59	11,971
1882 - 86	5,961	36	10,422	64	16,383
1887 - 91	7,016	38	11,617	62	18,633
1892 - 96	7,552	44	9,475	56	17,027
1897 - 01	4,065	43	5,329	57	9,394

On the face of it the pattern of the catches in the Dee were not dissimilar to Brora and Helmsdale: the Dee was an improving river. However, the bald figures obscure some significant differences, since the Dee at that period enjoyed inter alia a strong late-summer run of heavy fish (referred to later) apparently not enjoyed by Brora and Helmsdale. The increase of grilse 1881-1896 is obvious. There are no complete statistics for the period prior to 1872.

(ix) Spey

To the 1860 Salmon Commission the Duke of Richmond and Gordon submitted the catches made at his Spey salmon fishings:-

Table 44

Nets Catches in the lower River-Estuary-Coastal District of the River Spey

(Source: Salmon Commission, 1860, S.4152)

Year	Salmon	%	Grilse	%	Totals
1851	6,515	16	33,285	84	39,800
1852	10,980	19	46,041	81	57,021
1853	15,772	21	58,166	79	73,938
1854	29,780	45	36,148	55	65,928
1855	13,194	21	48,740	79	61,934
1856	14,103	34	27,528	66	41,631
1857	13,466	20	54,949	80	68,415
1858	30,840	47	35,409	53	66,249
1859	23,608	58	17,263	42	40,871

There was a discernable numerical and proportionate increase in salmon over the nine year period, particularly in 1858 and 1859.

To the Elgin Commission (1902) the Duke of Richmond and Gordon's representative provided details of the catches made at the Gordon-Richmond net fishings (river and coastal) of the Spey district over the years 1858-1899 inclusive. Since, however, the Duke did not desire to make public the actual quantities of salmon and grilse caught, his representative submitted the catches in the form of percentages above or below the average

in respect of each septennial period from 1858. It appears from the text that the average used was that for the whole of the period 1858-99.

In the following table the average of the period 1851-57 is of actual fish from the 1860 Commission (S.4152), and the subsequent percentages are as were submitted to the Elgin Commission based on the average for 1858-99:-

Table 45

Nets Catches in the lower River-Estuary-Coastal District of the River Spey

(Source: Salmon Commission, 1902, S.11490)

7 Yearly Averages	Salmon %	Grilse %	Totals
1851 - 57	14,830 25	43,551 75	58,381
1858 - 64	+ 5.2%	- 0.6%	-
1865 - 71	- 13.8%	+ 3.4%	-
1872 - 78	+ 4.8%	+ 2.8%	-
1879 - 85	- 10.3%	+ 5.8%	-
1886 - 92	+ 12.5%	+ 9.7%	-
1893 - 99	+ 1.4%	- 21.2%	-

Trends in the Spey did not appear to marked as for some other rivers during the fifty years period. A possible principal reason is that the grilse run after 1849 may not have deteriorated to the same extent as in some other rivers. One has to be careful when comparing quantities of fish during 1851-1899 with weights provided for this river in Section I covering 1810-1849, since there are indications that the potential of the Spey fishery may have been exploited more

thoroughly by the Dukes after 1850 until the 1880s to maximise catches and revenues. At any event, there seemed to be no striking movements in the proportions of salmon and grilse during the period after allowing for an increase of salmon in the later 1850s. There was a marginal increase of salmon in the 1870s, in line with a similar trend in other rivers. The grilse increased during the 1880s in line with events elsewhere. Also in common with other rivers was the decline of grilse during the last septennial period: the period of greatest decline would likely have been 1896-1899 (see Table 84 Section 3).

(x)

Table 46

Coastal Fishery over about three Miles in Kincardineshire, incorporating the lands of Balnagask, Altens, Loriston, Cove and Caernrobin

(Source: Salmon Commission, 1860, S.2935)

Six-Yearly Averages	Salmon	%	Grilse	%
1836 - 41	2,751	35	5,152	65
1842 - 47	4,140	34	8,173	66
1848 - 53	2,606	27	7,159	73
1854 - 59	4,237	41	6,094	59

This productive coastal fishery lies north of Montrose. As in the Spey statistics, there was a movement to salmon in the later 1850s, the salmon beating the grilse for the first time, by 6,719 to 5,227, in 1858.

(xi) Thurso

Table 47

Rod Catches January to 31st May in River Thurso

(Source: Annual Report of the Fishery Board for Scotland, 1885, Appendices, 123)
(Source: Salmon Commission, 1902, Appendix 14, 15)

5 Yearly Averages	Salmon
1853-54 (2 years)	368
1855-59	561
1860-64	830
1865-69	647
1870-74	784
1875-79	587
1880-84	495
1885-89	408
1890-94	396
1895-99	344

Netting in the river and in the district around its mouth was strictly controlled throughout the period. The spring run was preserved primarily for the rod fishing. Following indications of an increasing spring run between the 1850s and the 1870s there was a significant progressive decline during the 1880s and 1890s. The decline was particularly marked from about the year 1887, as in the Beauly.

(xii) Loch Tay

Table 48

Rod Catches January to 31st May in Loch Tay

(Source: Grimble, 1913, 281)
(Source: Calderwood, 1909, 88)

5 Yearly Averages	Salmon
1870-74	380
1875-79	693
1880-84	304
1885-89	329
1890-94	352
1895-99	250

Loch Tay was and is essentially a spring fishing. No catches were recorded before 1870. The decline indicated towards the end of the century is not dissimilar to events in other spring rivers. The scale of decline during the 1880s is somewhat out of balance and may have mainly resulted from a severe outbreak of salmon disease recorded during this decade in the Loch during the spring months (Grimble, 1913, 282, and others.) The rod catch in the season of 1882, when the disease had just started in the Loch and was at its most virulent, was only 139 fish. Whatever the effect of the disease in the 1880s, the spring catches were clearly much in decline by 1895-99.

This winter run of fish into Loch Tay was very early. After 1890 the angling season began on 15th January as compared to 11th February, and in 1891 81 fish out of a total catch of

325 were caught between 15th January and 10th February.

Figure 1 (next page) demonstrates the big general Scottish grilse run of 1895. Some southern Scottish east-coast districts enjoyed a good run in 1896. The 1895 season was the last one that enjoyed a general grilse run in Scotland on such a scale until the season of 1962, representing a cyclical interval of 67 years.

3. General Conclusions on the Changes 1850-1900 (as revealed by the In-Season Catch Statistics)

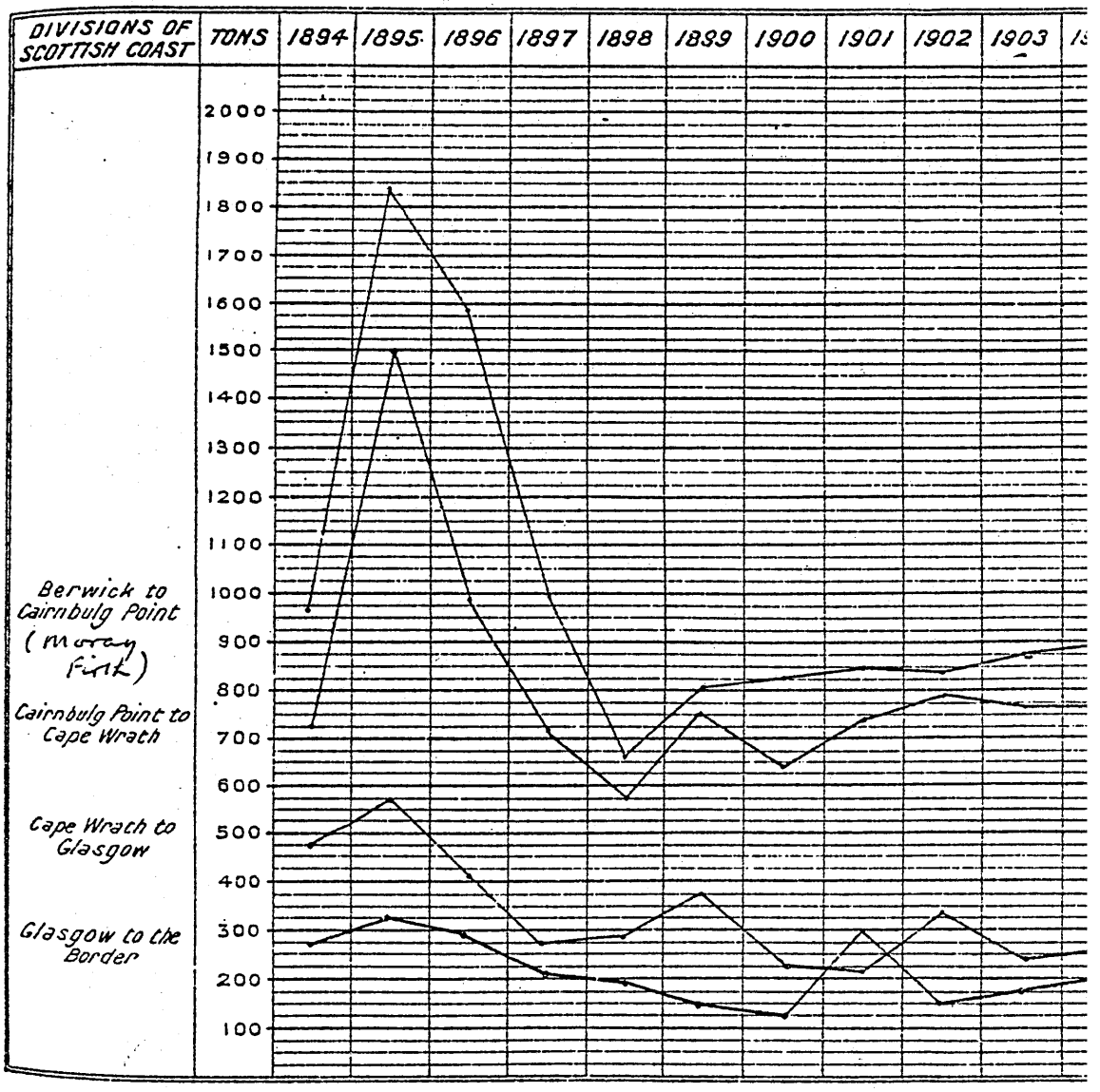
As regards grilse, there was an overall tendency following the great decline immediately after 1849 for the run to continue to decline at a much slower pace, from the 1850s through to the late 1860s and 1870s, both absolutely and as a proportion of the total run.

After 1880 a general increase of the grilse run occurred, very marked in most though not all rivers. From the total catches by individual year it may be seen that the improved grilse run was not consistent from season to season, a big run sometimes being followed by a considerably more modest run. The improved grilse catches continued until 1895 generally, 1896 in some districts, following which years there began a general decline of the grilse (statistically demonstrated in Section III).

The salmon - as opposed to the grilse - statistics present a much bigger problem of interpretation, since the evidence at face value is conflicting. It is clear that many seasons of the 1870s and early 1880s enjoyed good salmon runs. Catches for some rivers demonstrated an increase of salmon over the fifty

FIGURE 1

Graphs Showing Gross Tonnages of Salmon and Soles Carried by Railways and Steamships 1894 - 1903 (Source: Annual Report of the Fishery ... Board for Scotland, 1922.)



years, both in numbers and proportionate to grilse. In Brora and Helmsdale, at one extreme, the salmon nets catches continued increasing until the close of the period, whereas the spring rod catches in Loch Tay and in the Thurso, together with the salmon nets catches of early rivers such as the Beauly and the Findhorn, declined markedly towards the end of the period.

For the resolution of this disparate evidence an analysis of varying return-migration patterns in different rivers and also of fish weights is necessary. Consequently, a further chapter on general conclusions about the changes in the salmon run (i.e. older fish than grilse) during the fifty year period will be included later in this section.

4. Contemporary Comment on the Continuing Decline of the Grilse 1850-1880

Since the grilse catches given earlier are limited to a spread of rivers not all of which are covered for the full fifty years period, contemporary comment is invoked to fill out the picture.

A number of sets of rudimentary grilse average weight covering varying periods of years at fixed coastal nets in localities of the east coast, mostly in Aberdeenshire-Kincardineshire, were submitted to the Select Committee of 1860 (Salmon Commission, 1860, S. 2935, 3101, 3591, 3627.) Without exception, these catches indicate a decline of average grilse weight over the three years prior to the Committee hearings: i.e. 1857-1859 inclusive. One of the coastal netsman who gave evidence to the Committee was asked if the grilse had fallen off in size, in recent years. He replied: "The last three years they have..... The reason is that there was no late grilse; the greater part of

the grilse that I have had for the last three years were taken in the forepart of the season, hence the deficiency of weight..... last season the grilse fell off after the middle and end of June, when the fish should have been very plentiful, and in July we did not have any; hence we did not get the large fish, but only the small ones." (Salmon Commission, 1860, S. 2864, 2865.)

A questionnaire circulated by members of the Scottish Salmon Fishery Enquiry of 1871 evinced explicit response. A netsman on the Tay replied: "40 years ago three grilse were taken for one salmon; 10 years ago two for one; now, for some years back, the main take has been of salmon." (Scottish Salmon Fishery Enquiry, 1871, Appendix No. 2, 9.)

Among other replies to the same questions were included:-

Tay District:	"Few grilse run."
Deveron District:	"Few grilse run."
Ythan District:	"Very few grilse run."
North Esk District:	"No grilse."

(Ibid., 10.)

All these districts had been noted for grilse in varying degrees. Of course, these comments should not be taken too literally. They are examples of hyperbole. What they really mean is that the grilse run had declined in comparison with what it once had been.

An increase of grilse after 1880 is generally evident in the statistics covering grilse of all rivers in chapter 2 at some stage between that date and 1896, except in the Tweed. (The increase did show for Tweed in individual years when the

Scottish grilse run was generally heavy, but is not obvious in the periodic averages because of low catches in some seasons.) Also evident is a general decline of the grilse between 1896 and 1900.

5. Changes in the Salmon Run (excluding Grilse) 1850-1900

At this comparative stage in the first section (c.1790-1850) successive separate chapters related to the timing of the runs and to salmon and grilse weights. By virtue of the fact that neither the content nor the nature of the salmon run (excluding grilse) is clearly self-evident from the earlier net and rod catch statistics of this section, as compared to the statistics of the first section, which were self-explanatory, some analysis of return-migration time, weights and other factors that were discussed separately in the first section have had to be incorporated into this chapter. However, a more detailed consideration of weights generally is reserved for a subsequent chapter.

There is not much face-value statistical evidence pointing to, or contemporary verbal comment about, important changes in the overall salmon run during the 1850s, other than about the decline of the grilse. Indeed, witnesses giving evidence to the 1860 Commission were still reciting stories from forty and fifty years before:- ".....When I was a boy I have seen a salmon of 45 lbs or 50 lbs weight now and then; and out of a parcel of 100 salmon I would have taken out perhaps 5 per cent or 10 per cent of them weighing from 15 lbs to 24 lb. Now such a thing is hardly to be seen." (Salmon Commission, 1860, S.393.) In other

words, the picture painted to the 1860 Commission had much in common, as regards the pattern of the runs, with that painted in evidence to the 1836 Commission. The 1850s were noted by most contemporaries for a decline of fish, not for changes in return migration.

However, from the 1850s, through the 1860s and into the 1870s there developed a tendency, not always consistent, for salmon to increase numerically, not only proportionately to the grilse run but absolutely. This tendency is demonstrated in the earlier statistics. The increase was not proportionate to all rivers, but by some stage of the 1870s the trend had become marked in the catches of all rivers.

There were a few indications in the evidence to the 1860 Commission, hardly significant except in the light of subsequent events, that the run of both 2SW and 3SW fish, in rivers noted respectively for each class of fish, had started to increase in number. Replying to the question: "Notwithstanding the existence of those stake and bag nets, has the take of salmon increased?" the lessee of the salmon fisheries in the Thurso river and Thurso bay replied: "Yes, the take of salmon has increased." Later he continued".... We kill three times the spring fish in the river, and yet we kill fewer summer fish and grilse...." (Salmon Commission, 1860, S.924, 995.) The Thurso spring rod catches given in Table 47 demonstrate an increasing trend between 1853 and 1860.

There seems little doubt that the year 1860 marked a watershed in the movement back to salmon of heavier weights,

particularly in those rivers traditionally noted variously for heavy spring (3 and 4SW) and heavy summer fish (2 + and 3 + SW), after a comparative absence of some forty years. Observations to the 1860 Committee and from other sources offered evidence that this was so. A netsman on the Forth explained: "... At the beginning of this last month of February (1860) we had a very nice small water for three weeks, and we got 56 salmon the first day; among those 56 salmon there were only three fish below 12 lbs; the average was about 19½ lbs; and, in the 56, there were some as high as 28 lbs; they were all winter fish, a thing that we never saw in the Forth before for many years." (Salmon Commission, 1860, S.1280). A netsman from the Tay, giving evidence to the Commission on the same day, 8th June 1860, said that the early spring fishing of that year had yielded an improved catch of heavy salmon, including two of 52 and 54 lbs. (Ibid., S.1438, 1441, 1442.)

William Henderson's autobiography "My Life as an Angler" includes the following passage about the season of 1860 in the Tweed:

> "The following list of large salmon taken during the autumn of this year was obtained from the same source. I believe it to be correct as far as it goes, though doubtless many more 'heavyweights' were captured that did not come to my knowledge. I give the list, because it fixes the time when the beneficial results of returning the kelts to the river could first be measured (sic). The Act of Parliament (i.e. The Tweed Act of 1857) only came into operation in the

spring of 1858, at which time the capture of a 20 lb salmon was a rare event. By the autumn of 1860 few anglers fished the Tweed without taking one or more of still heavier weights." (Henderson, 1880, 245.)

(The proposition about the return of the kelts is fallacious, and could have had no more than a marginal influence on the increase of heavy fish. However, the contribution of the returned kelts to the stock of large fish was accepted at the time as being of extreme importance.) Later in the same volume Henderson quoted from a correspondent's letter about the autumn rod fishing on Tweed in the season of 1862: "....the number of large fish taken, at a time when the increase in the size of Tweed salmon had only just begun to be noticed. The total produce of my rod in the 19 days was 114 fish = 1,762 lbs weight." (Ibid., 259.)

Tables 33 and 34 (boxes of Scottish salmon sent to Billingsgate) shows that from 1850, at the termination of the great grilse period, through to 1861 inclusive there was a considerable decline in the average number of boxes per annum sent to market. But from 1862, the year that Henderson's correspondent specifically referred to, there was a significant and sustained increase in the number of boxes to Billingsgate. This improvement was not caused by an increase of grilse, since the run was in decline. There is no evidence of any sudden increase of netting. Equally, there is no evidence of a rapid or unusual increase in the price obtained for the product. The salmon run was tending to increase numerically, but only at a modest pace according to the available statistics. It seems probable that the main reason for the enhanced supply

evidenced from the season of 1862 was an increase in the average weight of fish caught, allied, of course, to the gradual increase of stock older than grilse.

The Tay has a reputation for heavy fish in both the early spring and in the summer (varying in quantities at different periods). Many of the net fisheries below Perth were let by the year, so that rentals quickly responded to an increase of the stock (or weight) of fish. The rentals of the Tay net fishings for the ten year period 1856-65 are as per Table 49:-

Table 49

Annual Rentals of the River Tay Net Fishings

(Source: Salmon Commission, 1860, S.196)
(Source: British Industries: Salmon Fisheries, 1877, 299)
(Source: Annual Report of the Fishery Board for Scotland, 1900, Part II, x)

Year	Rentals	Price per lb at Billingsgate
1856	£10,199	1/-⅛d
1857	£10,772	-/11⅜d
1858	£11,487	-/10½d
1859	£11,884	1/-⅞d
1860	£13,827	1/-d
1861	£14,009	1/-d
1862	£14,080	1/-d
1863	£14,232	1/-d
1864	£16,742	1/-d
1865	£17,618	1/2d

There was a significant increase of rentals in 1860 and again in 1864. By 1865 rents had increased by 75% in ten years. (The rental increases after 1864 were much more modest, rising to their highest figure of the century in 1900 at £22,548.) Prices per lb were not advancing in line with rentals: it seems the fishing was increasing its yield.

This movement from grilse to salmon, and particularly to salmon of a heavy average weight from about 1860, established a trend that endured for most of the remainder of the century, and was only partly qualified by the revival of the grilse run 1881-1896. Events in a selection of rivers may now be considered with a view to verifying this hypo thesis, which is not self-evident from the in-season net catch statistics, nor from any contemporary objective or explicit scientific or philosophical discussion.

Tweed

In his book of 1864 "The Salmon" Russel included a table showing the proportions of salmon and grilse caught each month throughout the netting-season in the Tweed "on an average of years." He did not indicate the span of years averaged or their dates. However, at the Elgin Commission hearings on the Tweed in 1900 reference was made to a table "put in before the last Commission in which was given the week when the greatest quantity of fish was taken....between 1842-1856 it was the third week in July." The Commission referred to must have been that of 1860, since the 1871 Enquiry was not a formal commission. The table in question was not reproduced in the minutes of the 1860 Commission (or at least not in the copy included in the British Parliamentary

Records of the British Library). Yet Russel gave detailed evidence in 1860, as recorded in the minutes. It is known, indeed it is stated constructively at various stages of the text, that not all evidence to the 1860 Commission was reproduced in full, i.e. the verbatim evidence was edited. The table provided by Russel in his book was probably the one, in an abbreviated form, presented covering 1842-1856 at the 1860 hearings, but not included in the official minutes. In any case, the period of years averaged must have been prior to 1858 because 1857 was the last Tweed season in which netting ended as late as 14th October. The table gave the following information on the proportions of salmon and grilse to every 1000 of each kind caught in the Tweed net fisheries:-

Table 50

Proportions of Salmon and Grilse in the Tweed Net Fisheries 1842-56

(Source: Russel, 1864, 65.)

	Salmon	% of Salmon Catch	Grilse	% of Grilse Catch
February (from 15th)	22	2	-	-
March	56	6	-	-
April	89	9	-	-
May	128	13	1	-
June	138	14	13	1
July	232	23	371	37
August	151	15	408	41
September	113	11	154	16
October (to 14th)	71	7	53	5
	1000	100%	1000	100%

The Scottish Fishery Board's Report for the 1892 season contained an analysis of the Tweed nets catches of salmon and grilse by month for the thirty years 1860-1889. The analysis was taken from a selection of the river nets and also of the coastal nets immediately outside the river mouth at both sides. The catches in the form of ten-yearly averages are given in Table 51:-

Table 51

Proportions of Salmon and Grilse in the River Tweed Net Fisheries 1860-1889

(Source: Annual Report of the Fishery Board for Scotland, 1892, Appendices, 196.)

	Salmon						Grilse					
	1860 - 69		1870 - 79		1880 - 89		1860 - 69		1870 - 79		1880 - 89	
		%		%		%		%		%		%
Feb.	24	2	46	5	46	5	-		-		-	
Mar.	66	7	100	10	98	11	-		-		-	
Apr.	86	9	115	12	121	14	-		-		-	
May	160	16	127	13	147	16	-		-		-	
June	108	11	89	9	93	11	21	2	27	4	21	4
July	206	20	111	11	110	12	397	40	242	37	215	38
Aug.	249	25	228	23	145	16	491	49	306	46	237	43
Sept. (to 14th)	101	10	172	17	134	15	91	9	83	13	84	15
	1000	100%	988	100%	894	100%	1000	100%	658	100%	557	100%

The yield of the Berwick Salmon Fisheries Company's Tweed nets (river only) were provided to the Elgin Commission in respect of the period 1860-1900. The catches of salmon and grilse were not, however, given monthly in the minutes, but by

year in percentage form, except those for the 14 days in September before the netting closed. To obtain percentages in the form of periodic averages the figures have been completely reworked. Since the previous table was compiled from a representative selection of both river and coastal nets, whereas the Berwick Salmon Fisheries Company's records were from just the river, only the Company's catches covering the hitherto missing period 1890-1900 are given in Table 52:-

Table 52

Proportions of Salmon and Grilse caught in September in Part of the River Tweed Net Fisheries 1890-1900

(Source: Salmon Commission, 1902, S.14705)

Averages	% of Total Salmon Catch made in Sept (to 14th)	% of Total Grilse Catch made in Sept (to 14th)
1890-94 (5 years)	16%	12%
1895-1900	21%	15%

The content of Tables 51 and 52 may now be summarised in percentage form for ease of comparison. The 1842-57 averages have been adjusted to assume the netting ended during this period on 14th September, instead of a month later. For this purpose notional catches are taken of 60 salmon (out of 113) for September, the catch of 71 salmon in the first half of October being an increasing catch compared to the September total; and 85 grilse (out of 154).

Table 53

Proportions of Salmon and Grilse in the River Tweed Net Fisheries 1842-1900: Summary

	Feb. (14 days)	Mar	Apr	May	June	July	Aug	Sept. (14 days)	Totals
				Salmon					
1842-57	3	6	10	15	16	26	17	7	100%
1860-69	2	7	9	16	11	20	25	10	100%
1870-79	5	10	12	13	9	11	23	17	100%
1880-89	5	11	14	16	11	12	16	15	100%
1890-94	-	-	-	-	-	-	-	16	-
1895-1900	-	-	-	-	-	-	-	21	-
				Grilse					
1842-57					1	42	47	10	100%
1860-69					2	40	49	9	100%
1870-79					4	37	46	13	100%
1880-89					4	38	43	15	100%
1890-94					-	-	-	12	-
1895-1900					-	-	-	15	-

The main salmon run in Tweed prior to 1858 was during the late spring and the summer, peaking in July. By the decade 1860-69 the June and July run was in decline, but the August-September run was considerably increased. By the next decade 1870-79 the latening of the main salmon run was such that 40% of the nets' numerical salmon catches were being made during the last few weeks of the netting season, and the last two weeks in September were proportionately by far the most productive weeks of the season.

By the 1880s the spring salmon catches (February to April) as a percentage of the whole had increased from 18-19% in the middle decades to 30% in the 1880s decade, but the total salmon nets' catch had continued to decline numerically. In the 1890s the September catches were proportionately greater than ever. One has to consider the possibility that by the 1870s, and for the remainder of the century, the main salmon run had moved out of the netting season altogether. The grilse run in percentage terms also tended to laten from the 1870s together with the salmon. Insofar as the grilse, as "short-trip" fish, are generally understood to frequent different sea-feeding grounds to those of the "long-trip" salmon this is interesting, since one might expect the return-migration habits of the grilse to be independent of those of the salmon in this respect.

The possibility, indeed the probability, that either the main salmon run or at least a substantial run had latened into the autumn months, after the netting season had closed, receives support from a number of sources. In 1870 T.T. Stoddart wrote to the Scotch Salmon Fishery Enquiry:-

> "That the breeding season of the Tweed salmon does not accord with that observed on the majority of our Scottish rivers, and that from a state of comparative regularity it has, in the course of a few years, lapsed into a state of disorder, is pretty well known; but it will hardly be credited that it is so completely deranged and put past the possibility of proper control, as to extend over a period of seven months; moreover, that the bulk of the breeding fish which, in our northern

salmon streams, leave the sea in August and September, do not affect the spawning grounds now-a-days until the winter months have fairly set in. Last year, 1869, the main body of salmon did not make its appearance until December - a heavy rear-guard composed of adult salmon and grilses followed it in January last....." (Scotch Salmon Fishery Enquiry, 1871, Appendix No. 7, 101.)

Although Stoddart isolated the Tweed, his comment was applied by other observers to many rivers later in the century.

From about 1860 autumn salmon fishing on Tweed (and other rivers) quickly became a popular sport commanding high rents. After kelt fishing was made illegal it became the custom for most Tweed riparian proprietors to let their fishing only during the autumn months. A detailed record (Table 54) of a lower river autumn rod fishery, together with weights, was submitted to the Elgin Commission:-

Table 54

Rod Catches in the Hendersyde Beat of the River Tweed between 14th September and 30th November 1873-1900

(Source: Salmon Commission, 1902, Appendix 5, 6.)

Year	Number of Salmon	Average Weight (lb) of Salmon	Number of Grilse	Average Weight (lb) of Grilse
1873	208	21.4	140	8.1
1874	82	20.2	44	6.9
1875	80	18.6	23	7.7
1876	79	21.2	39	9.0
1877	83	19.2	60	8.6
1878	57	19.9	12	8.2

1879	57	19.2	58	7.5
1880	69	19.4	15	9.0
1881	81	18.2	73	7.7
1882	80	19.0	15	7.2
1883	59	17.8	61	8.5
1884	140	20.2	58	8.3
1885	141	18.5	142	8.0
1886	167	18.6	45	7.9
1887	231	18.7	91	7.3
1888	41	17.0	23	7.6
1889	100	19.7	54	8.0
1890	46	19.7	35	8.3
1891	132	18.4	55	8.1
1892	131	18.6	28	7.9
1893	50	17.6	16	7.1
1894	41	14.1	10	7.2
1895	61	18.3	174	8.2
1896	102	18.1	26	7.2
1897	29	17.9	22	7.5
1898	111	18.5	18	6.7
1899	29	14.0	105	7.3
1900	80	17.3	32	7.4
	2,567		1,474	

The salmon were largely of the 2 + SW class, plus a few older fish. The autumn rod catches varied substantially from season to season, not just as a reflection of the quality of the run, but also much owing to the weather. Often there was a dearth of water early

in the autumn, but an excess of it later.

Tay

It is known from commentators back to Davy and Scrope that the spring fish of the Tweed are and were very largely of the small 2SW class, the reputation of Tweed as a big fish river relying almost completely on its late-summer 2 + SW and older stock. The Tay, on the other hand, has long had a reputation for both big spring fish and big summer fish. It is unfortunate that no netting records appear to exist for the period 1847 to the late 1890s, when the Tay Salmon Fisheries Co. was established. The association of netting interests that previously existed was dissolved in 1846 into numerous petty fisheries throughout the lower river and the long estuary.

Some information was provided earlier demonstrating the decline of the Tay grilse run, and the increase of heavier salmon from about 1860. Indications of the seasonal timing of these salmon during the 1860s were not exact, but by the early 1870s information from the rod catches enables one to see that in this decade there were apparently strong migrations of heavy fish both in early spring and in summer. Detailed records of rod caught spring fish in Loch Tay did not begin until 1870. Those for 1870-1899 were given earlier in Table 48 in the form of numerical quinquennial averages. The quinquennial average weights of fish over the same period are as per Table 55:-

Table 55
Average Weights of Spring Fish in Loch Tay
(Source: Grimble, 1913, 281: Calderwood, 1909, 88.)

5 Yearly Averages	Average Weights
1870-74	21.29 lbs
1875-79	22.32 lbs
1880-84	20.25 lbs
1885-89	19.56 lbs
1890-94	19.22 lbs
1895-99	18.58 lbs

From these weights it can be seen that the dominant class of fish in the spring rod catches was the 3SW large spring fish, undoubtedly with a small admixture of the 4SW class. Many of these fish were known to have entered into Loch Tay during the winter months November to February. The run went into numerical decline towards the end of the century.

As in the Tweed, there developed rapidly a popular autumn rod fishery in the Tay from the 1860s. Many fragmentary records exist; witness, for example, a catch of twenty fish made by two rods on the Cargill beat of the lower Tay on 10th October, 1872. The individual fish weights were given in lbs. as:- 11, 22, 20, 9½, 5½, 16½, 14½, 18, 26, 17½, 23, 14½, 7½, 18, 27, 11½, 12, 18, 5, 8. (Gathorne Hardy, 1898, 118.) They were probably a mixture of 1 + SW and 2 + SW fish, though it is not easy to distinguish the difference at the margin. (Perhaps there were 8 grilse of 5½ - 12 lbs, average weight 8.75 lbs., and 12 2 + SW salmon of 14½ - 27

lbs, average weight 19.6 lbs. Such average weights would be markedly similar to those prevailing at the same period in the Tweed for late-summer migrating salmon and grilse.)

By the 1880s all descriptions pointed to growing quantities of late-summer fish of increasingly heavier weights in the Tay. The Fishery Board Report for the 1885 season observed:

> "A great number of large salmon were captured during 1885 both by net and rod. On the Tay, salmon of 56 lbs, 55 lbs, 54 lbs, 53 lbs, 52 lbs, 51½ lbs, 50 lbs, and 49 lbs were taken by the nets, and a very large number between the last-named weight and 30 lbs. More than 50 salmon, averaging 45 lbs each, are estimated to have been taken during the month of August. The largest fish taken by the rod was captured on the Stobhall water, and weighed 47 lbs, but a great number were caught by anglers on various stretches of the river upwards of 30 lbs weight...." (Annual Report of the Fishery Board for Scotland, 1885, Part II, xxix.)

The "The Fishing Gazette" of 15th August 1885 contained a report on the Tay from P.D. Malloch, part of which read: "The quantity of salmon that has come up has been enormous. Over 20,000 salmon and grilse were landed with the nets from Monday till Wednesday night.... The salmon averaged 20 lbs and the grilse 7 lbs." (The Fishing Gazette, Vol. 11, 61.) 1885 was a very good season in the Tay, as elsewhere.

The Fishery Board report for the 1889 season was the only one at the period under disucssion to provide an estimate of the actual numbers of fish caught in the Tay District by all methods during that

season, which was not a good one. The Report observes:

> "As to the take of salmon, they (i.e. the clerks to the Tay District Board) estimate it at 28,000 salmon and 12,000 grilse by net and coble; 5,000 salmon and 2,300 grilse by fixed nets; and 1,500 salmon and 500 grilse by rods. At all seasons there are some clean fish in the Tay. The main take is in July and August, as to value perhaps in February, when the price is highest. The largest salmon caught in the Tay in 1889 were one of 67 lbs, by net, and a good number from 40 to 45 lbs. By rod, 57, 55 and 47 lbs." (Annual Report of the Fishery Board for Scotland, 1889, Part II, 15.)

P.D. Malloch, Managing Director of the recently-formed Tay Salmon Fisheries Co., gave evidence to the Elgin Commission in 1900. He said:

> "About the 20th August the great run of fish takes place; I am under the mark when I say during the last six days of the season 8,000 fish have been caught each year..... I have observed a great falling off in the numbers of fish.... more especially in spring and summer; up till the end of July the decrease has been enormous." (Salmon Commission, 1902, S.13654.)

At this period the Tay netting finished on 26th August.

To the same Commission Commander M. Dougall, trustee and manager of the Scotscraig Estate net fishery in the Tay estuary gave evidence:

> "Of late years the run has been later undoubtedly, but I should say that the real spawning run commences from the third week in September, and is sometimes as late as to the end of December... We have noticed that the run of fish has been later in the

season of late years than it used to be in 1860 or 1870" (Ibid., S.9975, 9979.)

Malloch gave details of eleven heavy Tay salmon 47-71 lbs caught, with one exception, by the rod, during his forty years on the river. The three of these fish dating from the 1870s were caught respectively in the months of March, June and July. Between 1883 and 1907 the remaining eight were all caught in October. (Malloch, 1909, 120.)

Allowing for the fact that the Tay salmon run was dissimilar to that of the Tweed, the latter having among other differences no considerable early spring run at the period under discussion, it is clear that they shared the experience of a striking latening of the main salmon run over the terminal decades of the century, together with a substantial increase of average weight. As the century neared its close the Tay late-summer run of heavy fish conspicuously increased, coincident with a decline of the heavy spring stock.

Forth

Many other of the more significant east coast rivers appeared to share the experience of the latening salmon run towards the end of the century. Events in the Forth-Teith, a system which had a salmon run similar in habit to that of the Tay, were described to the Elgin Commission:

> "....I think that the run of fish every year is becoming later and later.... The fishermen tell me now that it is hardly worth while putting a net in the tidal water in the Forth till about the middle of June. I believe they used to begin fishing in April or even before that. About the 'sixties the fishing got

to a very low ebb, and then they extended the close season, and the fishing improved.... I think they have been decreasing again, and they have certainly been very much later in coming up the river." (Salmon Commission, 1902, S.12288 to 12242.) (N.B. The period of "very low ebb" would probably have been the 'fifties rather than the 'sixties.) Another witness on the Forth commented:

"The last 10 or 12 years have been worse than the years before that. We do not get the same number of fish early in the year. For instance, we hardly get a fish now in the spring, whereas we used to get plenty of spring fish." (Ibid.,S.12172.)

It has been stated in regard to the Tay, and the same possibility is surmised in relation to the Tweed, that many heavy salmon of the 3 + SW class were apparently summer-running (i.e. May to July) during the 1860s and 1870s rather than autumn-running (i.e. August onwards) as they came to be during the 1880s and particularly the 1890s. The following description of the Forth return-migration is taken from a book published in 1885, but may reasonably be taken to refer to the general characteristics of the Forth run during the previous generation. It indicates a more or less continuing run of heavy 3 + SW fish of progressive weights in the 30-40 lb range from May to July:-

"There are every season five runs of salmon and three of grilse. The great run of salmon commences in December with the first spring tide - our winter salmon. They are large, coarse fish, from 16 lb to 30 lb, very lively in the net when caught, and very bold on the rod and line. The second is the first run of the young salmon, or spring fish; they are a fine-made and

delicate-looking fish, very lively, from 1½ lb to 10 lb. They first appear in February, rising 1 lb each spring-tide. The third is our summer salmon - a short-made fish, very sluggish in the net or on the rod, 12 lb to 30 lb; are first seen in May. The fourth are our autumn salmon - rather a smart fish for size, give great play on the line, appear in July, run from 16 lb to 40 lb each; the milt and roe appear far advanced; the male has a long beak. The fifth run are peculiar-looking fish, generally of a dark colour, some red and spotted; the male has a large milt and a very large beak; the female a very large roe. They give great annoyance to anglers, constantly leaping and disturbing the water; 12 lb to 30 lb each. It was supposed by the old fishermen they were the real breeders. If a wet autumn, they appear September 1; if dry, not till October 1...." (Willis Bund, 1885, 142.)

Aberdeenshire Dee

The late run of salmon was conspicuously increasing even in a river so traditionally early as the Aberdeenshire Dee. Sir Herbert Maxwell F.R.S. described the event:

"Always an early water, the average weight of the fish some years ago was very small. Since spawn has been taken from heavy Tay fish (sic) not only has the autumn angling greatly improved, but the average weight shows a marked increase." (Maxwell, 1898, 229.)

A "Fishing Gazette" of 1885 volunteered the following information on heavy rod-caught autumn salmon during that season on the Dee:

"In all about a dozen fish verging on 40 lbs, and several (more than half) of them over that weight, have been landed during the

present autumn fishing." (Fishing Gazette, Vol. 11, 207.)

Earn

Sir R. Moncrieffe gave information about trends in the Earn: "At present I think there are far too many fish come up at the end of the year to spawn. They are heavy, and cannot get far enough up the river.... These last three years there certainly has not been the same number caught. There is no doubt that the autumn run of fish has been very much later.... I would scarcely like to say that there were fewer fish in autumn. There are not so many spring fish...." (Salmon Commission, 1902, S.10001-10003.)

Spey

A netsman described the different classes of fish dominating the catches during various months of the Spey netting season, which may be summarised in the following way:-

	Weight	Class
February	8 - 9 lbs	2SW
May	12 - 14 lbs	2 + SW
June/July	Grilse	1 + SW
August	18 - 22 lbs	2 + SW

The netsman called February fish "spring" fish, May fish "summer" fish and August stock "autumn" fish. To the question: "When is the heaviest take of salmon?" he replied: "In August both for weight and quantity. It is the principal month all over. We reckon July for grilse and August for salmon." Later he observed: "...I remember one year - I think it was in 1894 - that we had a very bad fishing but it was not for want of fish - it was that they came in after we were finished." (Salmon Commission, 1902, S.15511-15520.)

The autumn rod fishing, with appreciable numbers of fish 30-50 lbs, on the lower reaches of the Spey in the 1880s and 1890s became renowned. (Grimble, 1913, 163-4.)

North Esk, etc.

Asked when was the main take of salmon, excluding grilse, the chief netting proprietor and lessee in the North Esk District replied that it was in August. (Ibid., S.15097.) In respect of virtually all the east coast districts south of the Moray Firth it was reported either directly or by implication that August was the main salmon month, though it was not always stated whether this was by virtue of numbers or weight, or both.

Thurso

The rivers north of the Moray Firth, from Beauly near Inverness on the east coast round to Naver on the north coast, were not noted for late-running 2 + SW summer fish. Yet in the Thurso a latening of the runs was reported towards the close of the 19th century, in line with the east coast rivers from Spey south to Tweed. It is possible that the late-running stock in the Thurso consisted substantially of grilse.

Evidence on the Thurso was submitted to the Elgin Commission: "They used to net early, but now it does not pay them. The spring run of salmon in the Thurso district has really come to a vanishing point." (Salmon Commission, 1902, S.14122.) This was probably exaggerated but, as may be seen from the spring rod catches provided in Table 47, a marked and progressive decline of the early run was indicated over the last two decades of the century. The Fishery Board Report for 1900 observed of the Thurso:

"The point worthy of special remark is that no sweep netting is

now carried on in the river, nor has more than a single net been used for a great number of years. Moreover, the number of rods at work all through the winter and spring is only six - the entire fishings of the river being leased to an association of six anglers. In the autumn the shooting tenants have the right of fishing. It is only within comparatively recent years that this autumn fishing yielded any sport, but it would appear that a change in the seasonal character of the river is being experienced as well as a decline in the actual stock. It is reported that while winter and spring fish are now very much fewer the autumn fish are more numerous...." (Annual Report of the Fishery Board for Scotland, 1900, Appendices 4.)

Writing of the years following 1887 Maxwell said: "Subsequent years exhibit a still further falling off in the returns for February and March, although the Thurso autumn fishing, formerly of little value, is now excellent." (Maxwell, 1898, 228.)

Naver

The Thurso was not alone among rivers of the neighbourhood in experiencing a decline of the spring run. Grimble wrote during the 1890s about the adjacent Naver, a river noted for its quality spring angling:

"It is certainly a very curious thing that the Naver take each season does not grow better and better instead of falling off; there must be a reason for this, which certainly is not over-netting at the mouth. To the west there are no bag nets, and to the east none for some distance...." (Grimble, 1913, 63.)

Beauly

For what are believed to be geophysical reasons the Beauly tends to be more of a grilse river at all periods than its northerly neighbours possessing similar district characteristics, but nevertheless the age composition of its return-migration does vary in line with the different cycles. Table 56 gives a breakdown by month of the Beauly nets catches over the seven-year period 1886-1892 inclusive and shows a significant decline of the spring run at just the same period recorded numerically or verbally in Thurso, Naver, Tay, Forth, among others:-

Table 56

Nets Catches in the River Beauly 1886-1892

(Source: Salmon Commission, 1902, Appendix 26.)

	1886		1887		1888		1889		1890		1891		1892	
	Sal.	Gr.	Sal.	Gr.	Sal.	Gr.	Sal.	Gr.	Sal.	Gr.	Sal.	Gr.	Sal.	Gr.
Feb	-	-	2	-	12	-	9	-	10	-	15	-	2	-
Mar	146	-	109	-	71	-	54	-	39	-	150	-	7	-
Apr	244	-	288	1	212	3	202	1	124	-	147	-	74	-
May	336	2	275	47	328	35	120	20	316	-	211	21	138	1
June	152	1232	114	1120	176	886	88	719	187	189	85	1272	96	391
July	181	2890	61	2863	122	1704	111	1369	101	2242	67	1785	132	2880
Aug	24	88	-	2	2	5	5	39	-	3	6	24	8	27
	1083	4212	849	4033	923	2633	589	2148	777	2434	681	3102	457	3299

After 1892 the then Lord Lovat reduced the frequency of the netting to two days a week, so the catches 1893-1899, which are available, would be invalid in a comparison with any periods 1856-1892 given in Tables 42 and 56. They are therefore omitted, but in any case confirm

the much reduced salmon run. The decline of the salmon catch, and particularly of the early spring catch, was marked between 1886 and 1892. The grilse run more or less held up, having regard to the fact that some years in the 1880s enjoyed exceptional grilse runs by the standards of 1851-1900. No information is available about the autumn rod fishing, which was probably let to the shooting tenants. It seems clear the netting finished at the beginning of August.

For all the rivers discussed there is evidence to indicate that the spring salmon run was in decline towards the end of the century, or that the late-summer run of salmon was increasing, or both. The general picture described permits an understanding of Sir Herbert Maxwell's general summary of the position in Scotland offered to Lord Elgin's Commission:

> "The first point on which I might offer some observations would be upon the alleged deterioration of the salmon fisheries all round the coast of Scotland. ....As far as my experience and observation go, I can confirm that as regards the spring and summer run of fish; I think that the autumn run in most rivers is as abundant as ever...." (Salmon Commission, 1902, S.10742.)

Brora and Helmsdale

Of all the examples that have been considered only two, the famous neighbouring early rivers of the Sutherland coast, Brora and Helmsdale, seem to provide evidence of a trend at variance with the generality of rivers, with the partial exception of the Dee. The catch statistics given in Tables 40 and 41 demonstrate a sustained increase in the salmon catches throughout the latter part of the century from the 1860s. This comment is also true of the grilse,

but the pattern of the grilse catches followed more closely the general pattern of the period. These catch statistics, as recorded by the year in an appendix of the Elgin Commission minutes, were not qualified in any manner, so that it seems reasonable to assume they were catches made during the full netting season, February to August. Calderwood referred to the historical nets catches of these two rivers in the relevant chapters of one of his books, and it can easily be seen that his reference was to the same catches submitted to the Salmon Commission. (Calderwood, 1909, 223 et seq., 228 et seq.)

> Of the Brora, referring to these catches, Calderwood said: "The mouth of the Brora is netted by means of net and coble after 1st May." Of the Helmsdale: "Sweep netting at the mouth of the river had previously been carried out for a long period, although since 1876 this netting began only on 1st May...."

Since the netting of both rivers was under a common management, it is a reasonable inference that the Brora netting also commenced on 1st May as from 1876. In other words, the increasing salmon catches shown in the statistics were of late spring and summer fish only as from 1876, probably including a majority of 2 + SW summer fish. Bag net fishing, under the same management, commenced on the coasts adjacent to both rivers from 1896, and the produce from these nets were included in the statistics (as evidenced by both the Commission records and Calderwood). Whether or not the bag nets commenced on 1st May also was not stated, but bag nets on such exposed northerly coasts would not usually start fishing before the later spring, and their produce would be substantially, if not entirely, of late spring and summer fish. This probably explains why the salmon were of such comparatively high average weights in the statistics.

This information also leads to the conclusion that the late-spring and summer run of salmon in Brora and Helmsdale increased significantly and progressively from the 1870s to the 1890s. The trend to a latening of the salmon run that resulted in an increase of late-summer in the southern rivers was perhaps reflected in Brora and Helmsdale by an increase of early-summer fish. Heavy late-running 2 + SW fish had always been in some degree characteristic of more southerly rivers from Spey to Tweed, but have never - on the available evidence - been markedly characteristic of most of the far northern rivers, occurring only in the odd unusual season. The contention receives support from the fact that the big runs of late-summer 2 + SW fish in southern rivers usually averaged of the order of 16-18 lbs or more in weight, whereas the Brora and Helmsdale summer salmon were of considerably lower average weights, presumably because - or at least partly because - they were earlier-running. (The weights of Brora and Helmsdale salmon and grilse are discussed later).

Reports from the rod fishing in both Brora and Helmsdale during the 1890s appeared to indicate, though not in a numerically significant form, that the spring runs of fish were increasing also. This seems to be at variance with the whole trend of the salmon run during the last two decades of the 19th century, as outlined earlier from events in numerous rivers. However, it has to be recognised that the great grilse decline from 1896 marked the end of an era, and that from the closing years of the century the first signs of the great early-running salmon cycle of the 20th century showed itself in a few traditionally early rivers, though not yet in many others. Such may have been the case with Brora and Helmsdale, based on the spring rod

catch general reports, and such may also have been the case to a degree in the Aberdeenshire Dee.

The following Table 57 which gives monthly the returns of Scotch salmon (by number of boxes) sent to Billingsgate Market over the seventeen years 1884-1900 shows the gradual general decline of the spring salmon throughout the period and also the decline of the grilse after 1896. The monthly and annual totals are not reduced to percentage comparisons because there is no division between salmon and grilse. However, the spring and summer catches are sub-totalled.

Table 57

Numbers of Boxes of Scottish Salmon of 112 lb each sent Monthly to Billingsgate Market, London, 1884-1900

(Source: Annual Report of the Fishery Board for Scotland, 1896, vi; ibid., 1900, vii.)

	1884	1885	1886	1887	1888	1889	1890
Feb.	1335	879	841	717	535	691	612
Mar.	1402	1116	1008	797	899	1006	902
Apr.	1973	1886	1744	1456	1096	1152	952
May	3162	2257	2485	2432	2603	1859	1844
Spring sub-total	7872	6138	6078	5402	5133	4708	4310
June	3821	3863	2896	3531	3953	3827	3127
July	8765	10582	8045	9544	7943	7414	7148
Aug.	6070	9151	5777	7794	5474	4826	4035
Sept.	691	628	611	636	356	326	311
Summer sub-total	19347	24224	17329	21505	17726	16393	14621
Grand Total	27219	30362	23407	26907	22859	21101	18932

Table 57 (Cont'd)

1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
934	1078	557	327	400	822	773	525	295	413
1116	1688	773	692	1207	1385	724	866	686	838
1403	1657	845	887	1160	1580	1038	809	759	943
2591	2125	1997	1745	2567	2376	2311	1430	1600	1697
6044	6548	4172	3651	5334	6163	4846	3630	3340	3891
4140	2438	3802	3078	4611	3595	3127	2668	3369	2522
8007	6259	5786	4464	9066	7450	5081	4166	4919	5012
7028	6064	4722	3968	5694	4477	3001	3169	3518	3213
670	610	421	328	659	750	213	487	264	453
19845	15371	14731	11838	20030	16272	11422	10490	12070	11200
25889	21919	18903	15489	25364	22435	16268	14120	15410	15091

6. General Conclusion on Changes in the Return-Migration of Salmon of older Sea-Life than Grilse 1850-1900

A cautionary note should be sounded as regards numerical comparisons between the quantities of salmon caught from the rivers and estuaries between decade and decade from 1851 to 1900 and also between the later 19th century and the early part of the same century. Between the early and the later parts there was a vast increase of coastal netting that invalidates the use of the produce of river and estuary by themselves as a basis for assessing the comparative size of the return-migration at different parts of the century. This is why it is necessary in a reconstruction of the runs of this period, to consider

carefully not only the implications of reported events from such major combined lower river and coastal fisheries as are available, but also the content and movement of the returns of Scottish salmon to the Billingsgate market, since this market obtained its produce from all types of fishery. Recorded catches in the rivers and estuaries are, however, reliable as long-term indications of the variations in the runs of salmon and grilse by age of stock.

The evidence of the combined catches and detail from all sources is that from the 1850s there was a considerable but gradual increase in the stock of salmon of older sea-ages than grilse, and of heavy salmon in these rivers noted for late-running 2 + SW and older fish. From the mid-1880s until the close of the century the overall salmon run and stock tended both to laten and to decline.

7. Salmon and Grilse Weights

The source documents of many of the catch statistics previously recorded did not include weights, or the salmon and grilse weights were aggregated and rendered unusable. However, a search independent of the catch statistics has thrown up some information.

To the 1860 Salmon Commission were submitted several sets of statistics from various east coastal net fisheries lying between the Moray Firth and the North Esk Districts, that provided details of average salmon and grilse weights throughout the netting season over varying durations between the late 1830s and 1859. These are summarised in Table 58, the salmon and grilse for each fishery being included under the corresponding number in each column. The key is: 1 = fishery over three miles of east coast in Kincardine-

shire, north of Montrose, comprising six named lands; 2 = fisheries of Findon and Portlethen, about six miles south of Aberdeen; 3 = Muchalls and Easter Muchalls fishings, south of Aberdeen; 4 = Woodston fishing, near Montrose; 5 = Burghead fishing, near Elgin.

Table 58

Average Weights of Salmon and Grilse at Various Coastal Nets Fisheries in Aberdeenshire and Kincardineshire 1836-1859

(Source: Salmon Commission, 1860, S.2935, 3101, 3591, 3627.)

Year	Average Weight of Salmon					Examples	Average Weight of Grilse				
	1	2	3	4	5		1	2	3	4	5
1836	12.1/8	-	-	-	-		4½	-	-	-	-
1837	12.1/7	12	-	-	-		5	5	-	-	-
1838	11½	10¾	-	-	-		4¾	4½	-	-	-
1839	12.1/5	12	-	-	-		4½	4½	-	-	-
1840	11.1/6	11	-	-	-		4¾	4½	-	-	-
1841	11.1/5	11	-	-	-		5½	5½	-	-	-
1842	12	11¾	-	-	-		5¼	5	-	-	-
1843	12¾	12	-	-	-		5¾	5½	-	-	-
1844	11¼	11½	-	-	-		4¾	4½	-	-	-
1845	10¾	11¾	-	-	-		5	5	-	-	-
1846	11½	12	-	-	-		4¾	4½	-	-	-
1847	11½	11½	-	-	-		4¾	4½	-	-	-
1848	11	12	11½	-	-		4¾	5	4½	-	-
1849	11¼	11½	10¾	-	-		4¾	5	4½	-	-
1850	12¼	12½	10½	-	-		4	4	3¾	-	-
1851	11½	11½	12½	12	-		4.1/6	4	4¾	4	-
1852	10.1/5	11	10¼	12	-		3¾	4	4	4	-
1853	11⅛	11½	12½	12	11.1/7		4¾	4¾	4½	4½	4¾

1854	11½	11¼	9½	12½	10.1/11		4¾	5	4¼	5	5.1/5
1855	10¼	10¼	12	11	10		4½	4½	4½	4¾	5.1/6
1856	12¼	12¼	12¾	13	11¼		4¾	4½	4¼	4½	4½
1857	12.1/6	12	12½	12½	11¼		3¾	4	3¾	4	4¼
1858	10¾	11	10¼	11½	10.1/9		3¾	4	3½	4	4.1/5
1859	9¾	10½	11½	10¾	9¾		3¾	3¾	4¼	3½	4.1/6

The average grilse weights were not high for a grilse-dominated period; even during a great grilse decade such as the 1840s the average weights of the grilse in the two/three districts in question were between 4½ and 5½ lbs. Following the termination of the great grilse migration, from 1850, there was a tendency for the average weights to decline, and this tendency became marked during the last three years 1857-1959 inclusive in all five of the fisheries shown. These weights support the oral testimony to the 1860 Commission quoted earlier, to the effect that the heavier late-running grilse had declined in number during the three years 1857-1859. Seemingly the salmon weights also were in decline by 1859 in these districts, logically signifying earlier-running fish.

There is some evidence that the modest grilse weights of 1840-1860 were not restricted to these districts located between the Moray Firth and the North Esk. Of the Tweed, much further south, during the same period Russel wrote: On a series of years, the average weight of the grilse captured on the Tweed fisheries was:

June	-	3 lb. 11¼ oz.
July	-	4 lb. 5¼ oz.
August	-	4 lb. 15 oz.
September	-	5 lb. 12½ oz.
October	-	6 lb. 11¾ oz.

(Russel, 1864, 77.)

The series of years in question was not stated but must have related to a period prior to 1858 when the Tweed netting continued into October.

These should be compared to the much heavier autumn grilse weights in Tweed shown by the rod catches covering 1873-1900 provided in Table 54.

Regarding Tweed salmon weights at the same period Russel observed:

> "Taking even monthly averages....the average weight of Tweed salmon in one month is 7 lb. 10¾ oz., and in another month 16 lb. 2¾ oz., and everybody knows that there are comparatively few salmon below the smaller of those monthly averages, and a great many above the larger - a fact corroborated by the month which shows the largest average weight showing the largest average number, and by the month which shows the lowest average weight showing also by far the smallest number." (Russel, 1864, p.78.)

This comment was part of the somewhat complex argument about the running-habits of salmon and grilse during the course of which Russel (1864, 65) provided information on the quantities of Tweed salmon and grilse by month per 1000 of each type (Table 50). In other words,

when Russel said that the Tweed month that showed the largest average weight for salmon also showed the largest average number he should logically have been referring to July; and when he said that the Tweed month which showed the lowest average weight showed the smallest number of salmon he should have been referring to the month of February. (The syntax is more than a little confused, almost as though Russel were looking at a list of monthly catches that terminated with July, since the average weight of the 2 + SW fish of August to October should clearly have been heavier than that of July, when the greatest number of salmon was caught. Certainly 7 lb. 10¾ oz. fitted the February 2SW fish, and the February nets' catch was the lowest monthly salmon catch. 16 lb. 2¾ oz. was a not unreasonable average for Tweed July 2 + SW fish, having regard to the fact that, in accordance with the progression of Russel's monthly catch tables, the main salmon harvest would have been during the latter part of July. There are several possible explanations:

(a) that such 3 + SW fish as existed at the period were running in the Tweed largely during mid-summer rather than, as occurred later in the century, during the late-summer and autumn months, thus increasing the July average salmon weight; there is evidence that this was in some degree the case in the Tay and the Forth at the period;

(b) that the heavier autumn grilse were classed as salmon by the netsmen, thus reducing the average weights of the declared salmon after July;

(c) that Russel's analysis was in some way erroneous: a not uncommon event in nineteenth century salmon texts;

(d) that he was referring to separate up-dated statistics in which August had become the main salmon month. However, it should be noted

that the low grilse weights given by Russel were not out of line with those of other districts at the period.)

A statement giving the produce, including average weights, of the last month of the netting season, from 14th August to 14th September (as it then was) in the Dee and the Don fisheries for the years 1853-1859 inclusive was handed in to the 1860 Commission, and is reproduced in Table 59:-

Table 59

Average Weights of Salmon and Grilse in Rivers Dee and Don 1853-59

(Source: Salmon Commission, 1860, S.604.)

	Don (Nether Don Fishery) (14th Aug to 14th Sept) (av. wt. in lbs.)		Dee (Raik Fishery) (14th Aug to 14th Sept) (av. wt. in lbs.)	
	Salmon	Grilse	Salmon	Grilse
1853	16.13	5.58	16.73	3.89
1854	16.45	6.21	16.50	5.96
1855	19.11	6.20	16.04	6.08
1856	17.76	5.99	18.17	6.18
1857	15.33	4.41	15.38	4.31
1858	14.84	3.98	14.99	3.93
1859	13.67	3.86	13.06	3.85

The August-September grilse weights 1857-1859 were remarkably low, and also to a lesser degree the salmon. It is probable that this decline was connected with a phase of the decline of grilse and possibly also the movement to salmon, i.e. to earlier running salmon in these two rivers. (The quantities of grilse and salmon caught provided with these weights indicated a significant numerical decline of late-running stock 1857-1859.) This statement may seem somewhat

paradoxical when it has already been argued earlier that from about this same period in Tay and Tweed there was a significant increase of heavier salmon in both spring (Tay) and summer (Tay and Tweed), but Tay and Tweed are (at most periods) different types of salmon river to Dee and Don and, moreover, it is a commonplace of the history of the runs that during periods of fluxing return-migration some rivers and groups of rivers exhibit certain marked trends when others exhibit different ones; at this period around 1860 in e.g. the Tay more 2SW and 3SW fish at all seasons; in Tweed more 2 + SW summer fish particularly; and in Dee more 2SW small spring fish.

The salmon (late spring and summer from 1st May) and grilse annual average weights for Brora and Helmsdale are available over the full period 1864-1899 (Table 60).

Table 60

Average Weights of Salmon and Grilse in Rivers Brora and Helmsdale 1864-99

(Source: Salmon Commission, 1902, Appendix 24, No. 7, 54.)

5 Yearly Averages	Brora		(lb)	Helmsdale	
	Salmon	Grilse		Salmon	Grilse
1864-68	11.11	4.62		10.69	4.35
1869-73	12.38	5.37		11.76	5.13
1874-78	11.96	5.68		12.32	5.27
1879-83	10.50	5.68		11.13	5.13
1884-88	10.54	5.27		11.87	4.92
1889-93	10.38	5.40		11.08	4.93
1894-99 (6 years)	9.92	5.13		11.57	4.83

The grilse average weights during the 1860s were low, though not out of character with weights in this river earlier in the century. From 1869 in both rivers there began a sustained increase of average grilse weights, so that throughout the 1870s the weights were unusually high by available historical standards for both rivers. This increase of weight occurred at broadly the same time as a significant increase in the weight of grilse in the Tweed (Table 54) far away, as well as similar indications in Tay and other rivers. How far the increase of the grilse weights in the two rivers was proportionate to month and how far it reflected a latening of the run is unknown, but a degree of latening would have been consistent with the considerable increase of weights and also with events elsewhere (e.g. Tweed). Similar to Tweed, Dee and other rivers the grilse run of the 1870s was of a modest proportion overall. The average weights of grilse 1894-1899 would have shown a greater decline than they in fact do had not the weights of 1895 been high - 6.20 lbs in Brora and 5.59 lbs in Helmsdale. The salmon weights of both rivers did not move quite in unison but there was the same marked increase of average weight in the 1870s seen in some other rivers. With the advent of increased catches in the 1880s and 1890s there was a marked decline in average weight in Brora, and a somewhat erratic pattern in Helmsdale. Without knowing the quantities of early-spring fish it is difficult to comment conclusively on the salmon run as a whole, but there were increasing quantities of late-spring and early-summer salmon during the 1880s and 1890s. As indicated earlier there are reasons (from rod catch indications) for believing the salmon run as a whole was increasing in both rivers during the 1890s. Moreover,

the decline of grilse and salmon weights in tandem may be consistent in this type of river with an increase of the early-running 2SW stock.

The Aberdeenshire Dee salmon and grilse average weights were:

Table 61

Average Weights of Salmon and Grilse in Aberdeenshire Dee 1872-1901

(Source: Annual Report of the Fisheries Board for Scotland, 1896, X.)
(Source: Records of Aberdeen Harbour Commissioners)

5 Yearly Averages	Salmon (lb)	Grilse (lb)
1872-76	11.72	4.48
1877-81	11.55	4.44
1882-86	10.75	4.69
1887-91	10.64	4.46
1892-96	10.71	4.50
1897-01	10.79	4.24

By the standards of many other rivers the Dee grilse did not seem large during the 1870s, but they were considerably heavier than they had been during the early part of the century. In some but not all of the enhanced annual grilse runs during the period 1881-1895 the average weight increased considerably over the 1870s levels, as in other rivers (see Table 102 section III). As regards the salmon run, the average weights were considerably higher during the 1870s than subsequently, as in Brora and Helmsdale and other rivers. Dee was similar to these two rivers in that there was evidence of the salmon run increasing during the netting season through the 1880s and early 1890s, in which trend they were at variance with many other

rivers. Except for the year 1895, the last of the great grilse years, when the average grilse weight was 5.21 lbs with a heavy run, the average grilse weight would have shown a considerable decline during 1892-96, as it actually did over 1897-1901.

The catches and average weights of salmon and grilse by month in the Dee and Don nets over the seven years 1894-1900 were given in the Elgin Commission minutes. The average catches and weights for the full seven years are provided in Table 62:-

Table 62

Average Numbers and Weights of Salmon and Grilse in Rivers Don and Dee 1894-1900

(Source: Salmon Commission, 1902, Appendix 23, 41.)

	Salmon		Grilse	
	Av. No.	Av. Wt. (lb)	Av. No.	Av. Wt. (lb)
Dee: Raik & Stell Fishings 1894-1900				
Feb.	722	8.32	-	-
Mar.	598	8.75	-	-
April	434	9.36	1	2.20
May	677	10.13	126	2.89
June	427	12.09	2,124	4.10
July	463	15.22	2,944	4.74
Aug.	560	17.32	732	6.04
	3,881	11.36	5,927	4.67

	Salmon		Grilse	
	Av. No.	Av. Wt. (lb)	Av. No.	Av. Wt. (lb)
Don: Nether Don Fishings 1894-1900				
Feb.	162	8.21	-	-
Mar.	298	8.14	-	-
Apr.	278	8.94	2	2.31
May	507	9.82	75	2.79
June	503	11.81	1,654	4.11
July	747	14.71	3,291	4.89
Aug.	1,238	16.79	1,585	5.92
	3,734	13.11	6,607	4.92

Then two individual years are analysed, 1895 and 1896, because 1895 was a big grilse year and 1896 the best salmon year of the seven, and these are given in Table 63:- (see next sheet)

Table 63

Average Numbers and Weights of Salmon and Grilse in Rivers Don and Dee 1895 and 1896

(Source: Salmon Commission, 1902, App. 23, 41.)

	1895					1896				
	Salmon		Grilse			Salmon		Grilse		
Dee:	Raik & Stell Fishings									
Feb.	1,582	7.96 lb				839	9.12 lb	-	-	
Mar.	915	8.22	-	-		1,783	9.30	-	-	
Apr.	298	9.34	2	2.50 lb		1,293	9.57	1	2.00 lb	
May	648	10.44	228	3.34		1,166	10.69	43	2.35	
June	599	12.56	4,779	4.41		834	12.67	2,574	3.91	
July	635	15.82	5,481	5.55		811	16.00	4,278	4.36	
Aug.	622	17.81	1,267	7.08		1,067	17.70	736	5.39	
	5,299	11.00 av	11,757	5.21	av	7,793	11.74	av 7,632	4.29	av
Don:	Nether Don Fishings									
Feb.	104	8.29 lb	-	-		304	9.26 lb	-	-	
Mar.	555	8.09	-	-		747	8.55	-	-	
Apr.	269	9.26	7	2.57 lb		662	9.34	-	-	
May	563	10.17	186	3.17		819	10.34	25	2.20 lb	
June	688	12.45	4,233	4.44		671	12.55	755	3.66	
July	679	15.17	5,911	5.68		1,274	15.73	3,077	4.43	
Aug.	1,243	17.06	2,821	6.96		1,737	17.60	693	5.27	
	4,101	13.08 av	13,158	5.52	av	6,214	13.34	av 4,550	4.42	av

Although they meet the sea almost together it is clear that Don was a much later river than Dee at this period. The Dee run at the period lasted throughout the season. Clearly there was a significant

autumn run during the 1890s in the Dee. The Don also had an early run but the main salmon migration was in the late summer, as in Tweed and Tay and others during the 1890s. The salmon stock of both Don and Dee was largely of 2/2 + SW fish. The grilse weights of 1895 were abnormally heavy in both rivers, reverting to the prevailing declining trend in the following year.

A comparison between the runs and average weights of the two rivers and corresponding details early in the century and in the late eighteenth century is informative (see Tables 20 - 27). Also the 1920s: Tables 103-14. It is seen that the Dee runs and average weights particularly varied considerably.

Following the introduction of annual statutory reports on the Scottish fisheries from 1882 and the start of the Fishing Gazette in 1880, additional random information on fish weights became available. Whatever the generality of the heavy grilse weights earlier noted in some rivers during the 1870s, it is clear that grilse of heavy average weights were widespread during the 1880s and early 1890s, a period of much enhanced grilse runs in many seasons as compared to the period 1850-1880. Traherne observed: "In the autumn of 1885, out of 163 fish killed on the Stanley water (i.e. of the Tay) by Sir Hussey Vivian Bt. and myself, only 59 scaled over 10 lbs. A great many of these 59 weighed 11 or 12 lbs, and they were all grilse." (Traherne, 1889, p.97). One might ask how Traherne, before the days of scale-reading, could feel so sure his fish were grilse. The answer is that he understood the bands of weight: Between 12 and 16-17 lbs there were hardly any fish. Of the Kirkudbrightshire Dee it was stated in the Appendices to the Report

of the Fishery Board for Scotland, 1883, 109: "In the second last week of July 1883 the average weight of the grilse caught at Tongueland was 8¼ lbs:" which is a very heavy average weight for the third week of July.

An extract from The Fishing Gazette for 1894 read: "....about all the fish caught since last reported have been grilse, but grilse giving a splendid average weight - about 8½ lbs. The Forth yields as beautiful large grilse as any fishery in Scotland...." (The Fishing Gazette, Vol. 29, 339.) The same volume described four rod-caught grilse on the Awe on 6th July as weighing 6½, 9, 7 and 7½ lbs; heavy weights indeed for the first week of July (ibid., 36). In his "Life History and Habits of the Salmon", published after the turn of the century but largely historical in content, Malloch described the Tay grilse run: "As the season advances, the weight of the grilse increases rapidly. At the end of June they weigh about 5 lbs., at the end of July 8 lbs., and at the end of August 10 lb. - exceptionally large ones weighing from 10 to 12 lb." (Malloch, 1909, 11.)

The Loch Tay spring fish weights have already been given (Table 55). Obviously they were very largely 3SW fish. The marginal decline of average weight as the numbers declined may have related to the 3SW stock, and it may in part have related to a decline of marginal 4SW stock.

Table 64 gives the Thurso the spring rod-caught fish averages:-

Table 64

Average Weights of Spring Salmon in River Thurso 1853-1900

(Source: Annual Report of the Fishery Board for Scotland, 1884, Appendix 123.)
(Source: Salmon Commission, 1902, Appendix 14, 15.)

5 Yearly Averages	lbs.
1853 - 57	10.21
1858 - 62	9.88
1863 - 67	9.79
1868 - 72	10.54
1873 - 77	11.47
1878 - 82	11.83
1883 - 87	10.99
1888 - 92	11.17
1893 - 97	11.43
1898 - 1900 (3 yrs)	11.69

In the 1860s, when the spring fish were numerous, the average weights - largely of 2SW fish - were low. There was the same increase of average weight noted in other rivers during the 1870s, when the stock was still large. Towards the end of the century, when the spring fish were declining in numbers, there was again an increase of average weight, possibly associated with a latening of the salmon run as a whole (i.e. proportionately fewer fish until April).

8. Salmon Rod Fishing

Unlike game shooting, which had by the nineteenth century already possessed a recognised sporting pedigree for centuries, only

during the course of last century did salmon rod fishing in Scotland become a popular sport commanding high rents. Prior to the first half of the century, and substantially before the 1850s and 1860s, salmon fishing with the rod was largely a local affair and, in Scotland at least, primarily associated with securing something for the pot. It is true that some of the Scottish landed grandees fished for sport within their domain, but angling visitors from other parts of Britain were rare specimens, and unknown in the modern sense. Sir Humphry Davy was one of the first at the beginning of the century. From the 1850s the popularisation of rod fishing for salmon quite quickly came to make a not insignificant contribution to the rural economy of Scotland by way of rent payments and the employment of keepers, gillies and boatmen, together with the growth of staffed estate lodges and sporting hotels offering angling facilities.

The development of salmon angling as a sport for visitors on the river Tweed was conspicuously in advance of the opening-up of the northern rivers, the reason being that the border Tweed was that much more accessible to the largely English gentry and merchants who popularised the sport in substantial degree. The author of "Days and Nights of Salmon Fishing in the River Tweed," William Scrope, became the first in a long line when he rented Lord Somerville's house and Pavilion Water near Melrose in the early 1820s. At that date sport with salmon was of a more catholic nature than today:-

> "....Scrope, on the other hand, a friend of Scott's friends, bringing gossip from London to the Tweed, delightedly joining in the fun of catching salmon, with a rod if possible, si non,

quocunque modo - that is, with a net or leister (i.e. spear), was born to share in a kettle of fish cooked with song and potations on the bank of the river where they had been caught...." (Arthur Ransome).

Before the advent of Scrope and his successors the Tweed had been a poor man's river:

"Individuals were then casually employed by the tacksman (i.e. professional fisherman) of the waters to fish for the one-half of what they could kill.... There were no gentleman fishers in those days as now to come three hundred miles in cold spring snows, lodging at the inns here around at some pound a day, besides both treating and paying the tacksman at a high rate, something like another pound for the favour of a liberty to starve and fatigue themselves on the cold water.... It was years after this ere Scrope came round and succeeded old John Wight and Geordie Sanderson, by trebling the rents of the Mertoun Waters, commencing what we may call the gentle epidemical mania for salmon fishing, which has had the effect of these great lordly pikes driving us smaller fry out of the water...." (Younger, 1840.)

Younger reported that one John Haliburton, a local man fishing for a living, rented the Dryburgh water for £15 a year, before the sporting visitors started pushing up the rents, and that the £15 included, besides the fishing rights, the ferry boat and its revenues together with "a cow's grass." The rent permitted fishing by any recognised method: net, rod, spear. Grimble recorded that in 1838 one C. Grant took a lease of the rod fishing on four miles of the

best of the Spey for the sum of two guineas (Grimble, 1913, 161.)

The early spring fishing in Tweed so popular with visitors pace Younger was essentially for kelts. There is ample evidence in many records that such was the case. Henderson's diary stated without equivocation:

> "1840: In the first week of March I entered upon my new career as an angler for salmon. Long practiced as I was in fishing for trout the conventional modes of casting and playing the fly came easily to me, and so far as I could judge I was soon as successful as my brother anglers. The fish taken were generally from 8 to 15 lbs. in weight; all were kelts, and doubtless had been much heavier when they came from the sea the autumn before." (Henderson, 1880, 112.)

Of course, a few clean fish were caught in the spring. Henderson's spring fishing just described was at Dryburgh, well upstream. After a few years he rented a fishing much nearer to the tide, and in 1849 his diary recorded:

> "My first fishing this year commenced on February 27, but though I remained at Sprouston till March 8 the river was so much flooded that there were only two days on which it was possible to fish. On the 27th I fished from Rosebank downwards with Charlie Kerss and captured fourteen fish, three of which were new run. They were chiefly taken with minnow, the water being clear and low and the air frosty. It is very unusual to take so many clean fish so early in the year; these three were all taken in shallow quick-running streams." (Ibid, 166.)

By the end of the century it had become the practice to draw a

veil over the kelt fishing proclivities of the previous generations, so that by the time of Grimble's volumes of the 1890s there was scarcely the most indirect of allusions to the sport so assiduously practiced on Tweed and many other rivers before the legislation of the third quarter of the nineteenth century outlawed it.

In Humphry Davy's "Salmonia" of 1828 it is quite clear that no stain whatever attached to kelt fishing at that date. By the 1850s a strong groundswell was running against the practice both of kelt fishing and "burning the waters" (i.e. salmon spearing with lighted brands by night: the "Nights" of Scrope's "Days and Nights of Salmon Fishing"). This latter sport, so popular not long before with Sir Walter Scott, Scrope, and the local squirearchy, was referred to by Younger in 1840 as: "The worst of all freshwater piracy - desperate, daring, cruel, devilish." Of the former Stoddart observed in the 1850s:

> "The extension really required, and which in the main run will favour the true sportsman, is that of the fence (i.e. closed) season during the spring months. Postpone the opening of the rivers above its estuary until the middle of March, and what is saved to Tweed, in the way of giving opportunity for the largest description of salmon baggits to spawn and kelts to escape, is beyond reckoning.... By means of the rod, constant and extensive massacres of these fish (i.e. baggots) and kelts take place during the first four weeks of the season, and although a clean salmon is occasionally captured, the event is so rare that the local newspapers generally seize upon it as a triumph worth recording.... The wholesale slaughter of kelts has commenced this year (1853)

with more than wonted vigour. At Tweed-mill, Twisel and other netting stations, hundreds of these fish and, I have reason to believe, included under the same appellation a large number of kippers (i.e. gravid cock salmon) and ripe baggits, or unspawned salmon, were captured and slain in the opening week of the season. These, I am told, fetch at present at their marketplace at Berwick, 4d and upwards per lb...." (Stoddart ed. Maxwell, 1923, 224.)

During the decade from 1850 the popularity of salmon angling as a sport increased at an unprecedented rate. From 1853 the Thurso spring run was preserved primarily for the rods, the estuary and river netting being much reduced. The neighbouring Naver followed in similar manner at about the same time. Of the Sutherland Helmsdale Stoddart commented in 1853:

"The rod, of late years, has been substituted for other modes of killing fish.... The salmon fishings on the Helmsdale are generally, I understand, let along with the shootings on its banks, at a rent of £250 to five sportsmen.... The Brora, in 1851, was let for £200 to Mr. Ackroyd, with right to sub-let.... In that year, before the middle of May, or commencement of the grilse fishing, one rod secured 71 clean salmon."

These were all far northern rivers. Commenting on these rents in a footnote to his 1923 edition of Stoddart's book, Sir Herbert Maxwell observed:

"The rents mentioned here, as elsewhere, bear, of course, a very small proportion to those obtained since the railway was opened from Inverness to Thurso...." (Stoddart, 1923, 277.)

Henderson outlined the change in the Tweed angling rents between 1840 and 1880:

> "In making my arrangements with Adam (Johnston, the Tacksman) it surprised me to find his terms so exceedingly moderate. A day's fishing, including boatman and use of boat, was then 5/-d. At the present time a rent of £200 a year and all attendant expenses are paid for the water which I was then free to roam at will. This will show how great a change has been produced in the value of Tweed fishings by the competition of gentlemen eager for this noble sport."

In many of the small, early northern rivers after 1850 the whole fishery was rented by the sporting interests and the nets not used in river and estuary, or used sparingly, often only during the summer months. The great estates owning such rivers yielded sport virtually throughout the year, as the angling was good during the spring run from February or March, during the grilse run of June and July, given water, and from August the shooting took over through into the autumn or winter. South from the Moray Firth the most popular season for salmon angling in most rivers came to be the autumn, certainly from 1860. This partly reflected the growth of the late-summer run of heavy salmon and grilse described earlier, and partly reflected the fact that many of the most prolific major east coast rivers were intensively fished commercially until the end of the netting season. The salmon legislation of the 1850s (Tweed) and the 1860s reduced the volume of river netting; later in the century lower river nets in various rivers were bought out.

As the century advanced the angling season of many rivers was

extended further into the autumn. Here again, this in part reflected the continuing latening of the run towards the close of the century; but it reflected also in part pressure from the angling interest for improved facilities. Between the late 1850s and the opening years of the present century the angling season was extended, to give examples in regions far apart, from 7 November to 30 November in Tweed; 10 October to 15 October in Tay; 14 September to 5 October in Thurso; 31 October to 15 November in Annan, among numerous other rivers. Autumn salmon angling became such a popular sport and social pastime that the lists of tenants on quality beats read like a social register. Fishing Gazettes would solemnly announce that:

> "The lets on the River North Esk of the principal beats for autumn salmon fishing this year are: "Inglismaldie Castle: Mr. Thos. Cordes; Hatton and Kirktonhill: (Hon.) Mr. Edward Drummond; Craigo: Mr. E.M. Crossfield (sic); Canterland: Lord Cavan; Morphie: Sir John Gladstone, Bart." All these tenants were prominent in contemporary political, military and sporting circles. (Fishing Gazette, 29, 79.)

The rents paid for good salmon angling multiplied between 1850 and 1900. In 1877 it was reported of the Tweed:

> "The angling on the Tweed in autumn is first-rate, and larger rents are now paid for some of the best angling waters than are given on any other river in the United Kingdom. How rapidly their value has risen may be judged of by the fact that the assessable value of the angling waters rose in the first five years after the passing of the Tweed Fisheries Acts (i.e. in 1857 and 1859) from £898 to £1,857 a year; and it is now further

increased to upwards of £4,000." (British Industries: Sea and Salmon Fisheries, 1877, 267.)

The Fishery Board for Scotland Report, 1900, Season contains a table (see Table 65) demonstrating the greatly increased value of the angling rents in the Aberdeenshire Dee over the last three decades of the nineteenth century:-

Table 65

Fishing Rentals in River Dee

(Source: Report of the Fishery Board for Scotland, 1900, xi.)

Year	Coast Fishings	Estuary Nets	River Nets	Upper River	Total
1872	£ 3,309	£ 2,118	£ 350	£ 1,254	£ 7,031
1882	£ 3,427	£ 2,078	£ 300	£ 3,751	£ 9,556
1892	£ 3,243	£ 2,514	£ 267	£ 6,312	£12,336
1900	£ 4,368	£ 3,239	£ 444	£10,939	£18,990

The Upper River rentals column demonstrates that the angling rents on the Dee had increased by nearly 1000% over 28 years.

The 19th century witnessed a gradual decline of river netting that was beneficial to the sport of salmon angling. At the beginning of the century commercial salmon fishing was a river and estuary affair. By the end of the century it was largely a coastal and estuary business. Other factors encouraging salmon angling were the growth of the railway system from the 1830s and the affluence of the merchant classes.

CYCLICAL VARIATIONS IN THE RETURN MIGRATION OF SCOTTISH SALMON BY SEA-AGE c. 1790 TO 1976

SECTION III: 1901 - 1951

Section III

Chapter Headings

1. Introduction

The opening two decades of this fifty year period were ones that witnessed great changes in the return-migration patterns of both salmon and grilse in the Scottish fishery. These variations related not only to sea-age but also to season of migration within the age-classes, particularly as regards salmon.

The late years of the 1890s subsequent to 1895 had experienced a marked and rapid decline of the grilse run. By that decade the main salmon run of 2SW and older fish, on a trend of some thirty years, had become in substantial part summer and autumn-running in the prolific rivers and districts of the east coast, at least between the Moray Firth and the Borders.

The earlier part of the present century saw a continuation of the grilse decline culminating in a nadir that occurred at varying intervals from district to district during the fifteen years 1915 to 1930. The same period was conspicuous for a gradual decline of late-summer and autumn running salmon (2 + SW and older stock) contemporaneous with a gradual increase of the early-running "spring" salmon (2SW and older.)

These events are described in some detail in the following chapters. The general picture during the whole of the fifty years period as reflected by nets' and rods' catches in noted rivers and districts of the first class or good second class is offered in the next chapter. These rivers and districts include Tweed, Forth, South Esk, North Esk, Aberdeenshire Dee, Spey, Beauly and Thurso.

The third, fourth and fifth chapters review respectively the decline of grilse, the decline of late-running salmon and the increase of early-running salmon, including the principal characteristics of these changes together with an indication of their degree of immutability during the second half of the period from the 1920s through to 1950.

The penultimate chapter reviews variations in the weights of fish by age-class and their significance, and the seventh and final one briefly alludes to reported changes in return-migration patterns in other countries that occurred at approximately the same periods in Scotland.

2. Statistics of Catches of Salmon and Grilse at various Net and Rod Fisheries

Returns of Scottish salmon and grilse to the Billingsgate Market covering the period 1834-1900 were given earlier as a reliable general indication of the return-migration by weight. From the turn of the century these returns, which do exist, became increasingly unreliable as a guide to the catches and to the well-being or otherwise of the salmon fishery.

The Fishery Board Report for 1906 observed:

"The decrease in the number of boxes sent to Billingsgate continues. This decrease is, however, primarily caused by the growing practice of sending Scottish salmon to markets other than Billingsgate. In 1906 only 12,282 boxes of salmon were marketed in Billingsgate, showing a decline on the total for 1905 of 2,086 boxes." (Report of the Fishery Board for Scotland, 1906, viii.)

The Fishery Board Report for 1934 commented:

"The Fishmongers Company issue a statement annually of the number of boxes of salmon delivered at Billingsgate together with the country of origin of the fish. Up to the early years of this century this statement served as an index of the Scottish supplies, but owing to the changed conditions of marketing Scottish fish, whereby much of it is now despatched direct to its final destination, the Billingsgate figures form little guide to the actual catch. As a corrollary it may be mentioned that from the figures for the number of boxes delivered at Billingsgate it is apparent that in every month of the year until July the deliveries of Irish fish are from two to three times as great as those from Scotland, although the total Irish catch is in fact less than the total Scottish catch." (p.65.)

In lieu of the Billingsgate returns, the weights of salmon carried by the Scottish railway and steamship companies are offered in the form of a graph (Figure 2) demonstrating the quinquennial average weights in tons over the period 1894 to 1938, the graph being compiled from information provided in the Fishery Board for Scotland's Reports for the years 1934 (p.65) and 1938 (p.66); at which latter year this information terminated because of the war; it was not continued 1946-50 in this form. These combined railway and steamship tonnages are gross in the sense that they include the weights of boxes and of ice. They also include a modest amount of excess weight above the actual weight of salmon carried, by virtue of double-handled fish

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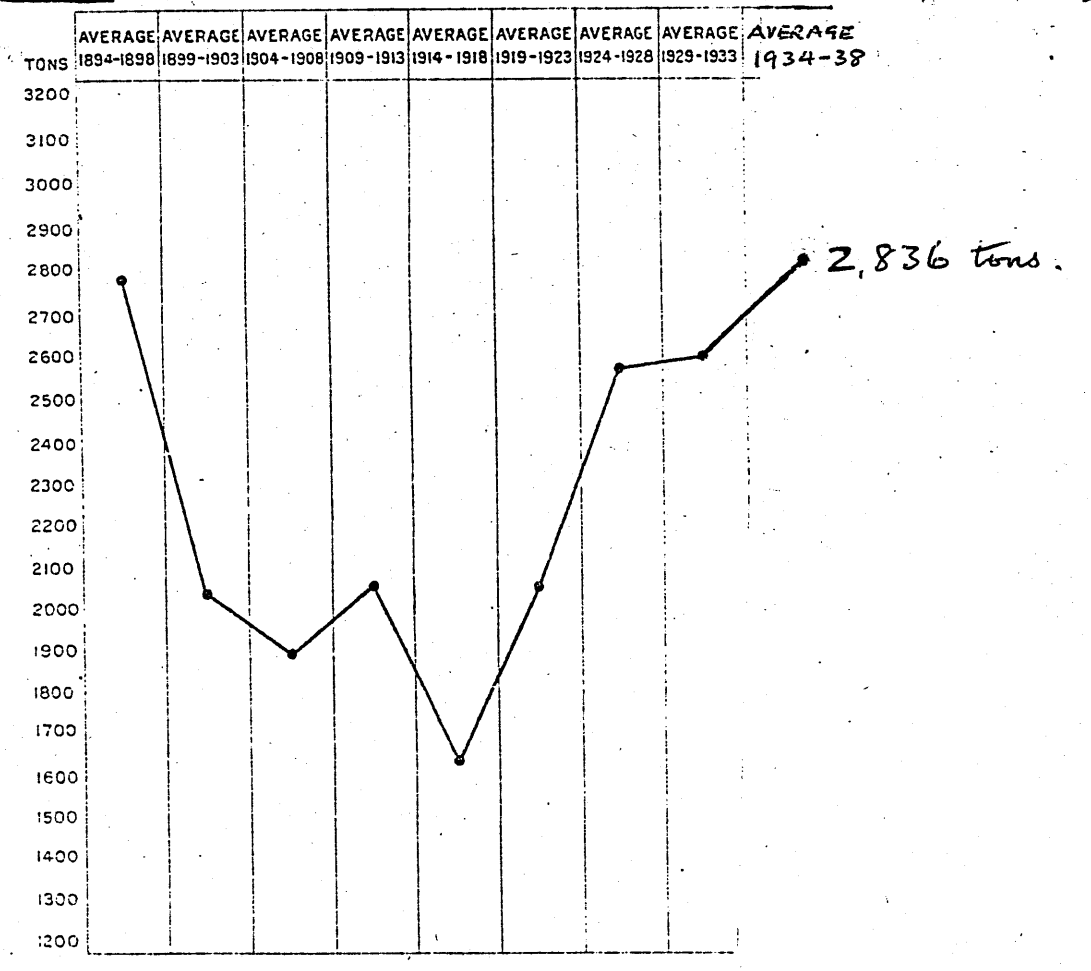
FIGURE 2

WEIGHT OF SALMON CARRIED BY RAIL AND SEA FOR THE PERIOD 1894 TO 1933 (Gross) SHOWN IN QUINQUENNIAL AVERAGES

(Including Weight of Boxes and Ice)

(Source: Annual Reports Fishery Board for Scotland, 1934, 65; 1938, 66.)



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3. Scottish Investiga
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4. Surface Drift-Bot
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through re-railing being counted twice. But as indications of trend they are probably thoroughly reliable, being consistent in their compilation and supported by all other source material.

The graph clearly indicates a marked deterioration of catches by weight that occurred after the quinquennial average figure for 1894-98 (which period incorporated the last great grilse seasons of the nineteenth century.) This period of decline lasted for some twenty-five years until the upsurge of the 1920s and 1930s which, as will be demonstrated, consisted overwhelmingly of salmon, and substantially of winter-spring - and early summer-running fish.

The Annual Reports of the Fishery Board for Scotland for 1950 and 1951 provide tonnages of salmon, grilse and sea-trout carried by the railway and steamship authorities over the period 1937 to 1950 inclusive. These figures are estimated net of the weight of boxes and ice and for quantities of re-railed from collecting centres:

Table 66

Net Weights of Salmon and Grilse Transported by Rail and Sea 1937-50

(Source: Report of the Fishery Board for Scotland, 1948, 90; 1950, 61.)

Season	Tons	Season	Tons
1937	1,512	1944	1,025
1938	1,229	1945	658
1939	1,193	1946	732
1940	1,098	1947	809
1941	972	1948	935
1942	1,052	1949	1,262
1943	1,269	1950	968

Comparative gross tonnage figures, as employed in the graph 1894-1938, for the years 1937 and 1938 are 2,931 and 2,316 respectively. After 1937 the annual catches tended to deteriorate until a nadir was reached in 1945. From that season the catches tended to improve on a modest scale, until by 1948-1950 they had about returned to the levels of the late 1930s and early 1940s, but not to the high average levels of 1921-1937.

The South Esk

The combined catches of the four stations comprising the Rossie net fishery near the mouth of the river South Esk at Montrose, unlike many coastal fisheries, offer a reasonably representative picture of the total return-migration occurring during the netting season, since they include not only summer fish but also spring fish, in which particular they are similar to the Rockhall and Kirkside coastal fisheries north of the mouth of the river North Esk, the catches of which are given in Tables 68-70.

The statistics of the catches made at the Rossie fishery over the fifty years 1900-50 have been divided as between salmon and grilse and also as between spring and summer salmon (Table 67).

As regards grilse they indicate a steady decline of the run over the fifteen years 1910-25 followed by a collapse during the subsequent quinquennial period 1925-29, with a modest recovery from 1930 which was more or less maintained over the decade thereafter and into the early 1940s. During the mid-1940s the run again faded to a low level and remained so until the end of the period.

Between 1900 and 1920 there was a gradual improvement of the numerical salmon catch, combined with a marked change in the pattern

of the seasonal return-migration. The late-summer run of salmon decreased substantially over the twenty years, but the spring run increased appreciably. This improvement continued during periods of the 1920s and the 1930s. Throughout the thirty years 1920-1950 the main catch of salmon was in April, May and June, as compared to the opening decade of the century when August produced the main salmon catch (more detailed analysis of the August catches are provided later).

The final quinquennial period 1945-50 saw the salmon run at a comparatively low ebb.

Table 67

Numbers of Fish Caught in the Rossie Coastal Nets of the South Esk District 1900-50

(Source: Joseph Johnston & Sons Ltd., Records)

Quinquennial Averages	Salmon Feb-May	%	Salmon June-Aug	%	Total Salmon	% Total Catch	Grilse	% Total Catch
1900-1904	767	43	1,004	57	1,771	51	1,685	49
1905-1909	691	40	1,046	60	1,737	49	1,788	51
1910-1914	1,033	52	939	48	1,972	58	1,418	42
1915-1919	1,261	60	832	40	2,093	61	1,325	39
1920-1924	1,152	57	870	43	2,022	65	1,093	35
1925-1929	1,301	63	761	37	2,062	77	625	23
1930-1934	962	56	751	44	1,713	58	1,254	42
1935-1939	1,307	63	759	37	2,066	66	1,061	34
1940-1944	1,057	52	984*	48	2,041	63	1,181*	37
(1945-1950 ((6 years)	896	60	589	40	1,485	67	748	33

* Average of 4 years only: No fishing after 8 June in 1940 due to war.

The North Esk

The three Tables (68,69,70) relating to the North Esk District provide details of (a) numerical total catches 1900-1950 at the Rockhall netting station divided as between salmon and grilse; (b) The Kirkside netting station monthly catches of salmon and grilse over the period 1900-1921; (c) the Rockhall netting station monthly catches over the period 1919-1950. Kirkside and Rockhall are located within a short distance of each other to the north of the mouth of the North Esk in a prolific district for migratory fish.

Because salmon netting companies fail by tender to renew netting right leases periodically, it has not been possible to offer the total catches of salmon and grilse in a single North Esk fishing. Messrs. Johnston of Montrose possess the outline catches of salmon and grilse for the Rockhall fishing over the full fifty years but the fishing rights over 1900-1918 did not belong to them, and the total catches over this period were provided by Messrs. Speedie when the fishing was taken over from them by Messrs. Johnston in 1919. Consequently the Rockhall analysis covers 1919-1950. In lieu, the records of the almost adjacent Kirkside fishing, which is not dissimilar in nature to Rockhall, are employed to show a picture of events 1900-1922, at which date it ceased to be fished by Messrs. Johnston.

In brief, the proportion of salmon in the catch gradually increased at the expense of grilse from the opening decade to the third decade, salmon remaining dominant until the end of the period.

The Kirkside and Rockhall detailed records indicate that the late-summer run of salmon, particularly during August, was dominant at the beginning of the period, whereas progressively from 1910-14

the July-August proportions declined and the March-June proportions increased, the August proportion continuing to decline right up to 1945-50.

As regards grilse, the catch declined continuously from 1900-04 to a nadir over 1925-29. It improved during the 1930s, again deteriorating during the final decade of the period.

Table 68

Numbers of Fish Caught in the Rockhall Coastal Nets of the North Esk District 1900-50

(Source: Joseph Johnston & Sons Ltd., Records.)

Quinquennial Averages	Salmon	%	Grilse	%
1900-1904	1,559	47	1,782	53
1905-1909	1,384	40	2,059	60
1910-1914	1,726	47	1,932	53
1915-1919	1,297	54	1,105	46
1920-1924	1,867	59	1,291	41
1925-1929	2,488	72	968	28
1930-1934	2,419	53	2,162	47
1935-1939	2,845	62	1,740	38
1940-1944	2,108	65	1,111	35
1945-1950 (6 years)	1,552	67	774	33

Table 69

Numbers of Fish Caught in the Kirkside and Associated Coastal Nets of the North Esk District 1900-21

(Source: Joseph Johnston & Sons Ltd., Records.)

Quinquennial Averages	1900-04		1905-09		1910-14		1915-19		1920-21 (2 Years)	
	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%
February	148	5	88	5	164	6	132	5	412	10
March	179	6	132	7	389	14	233	10	750	18
April	383	12	206	11	570	20	360	16	521	13
May	680	22	309	17	629	22	761	32	1,133	27
June	452	15	287	16	389	14	554	23	778	19
July	419	14	322	18	292	10	160	7	376	9
August	817	26	454	26	384	14	168	7	169	4
	3,078	100	1,798	100	2,817	100	2,368	100	4,139	100
	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%
April	1	-	2	-	1	-	-	-	-	-
May	37	1	29	1	11	1	30	2	5	-
June	706	19	553	22	596	29	782	40	384	27
July	2,185	59	1,624	63	1,132	56	1,018	53	965	68
August	787	21	360	14	296	14	98	5	63	5
	3,716	100	2,568	100	2,036	100	1,928	100	1,417	100

Table 70

Numbers of Fish Caught in the Rockhall Coastal Nets of the North Esk District 1919-50

(Source: Joseph Johnston & Sons Ltd., Records.)

Quinquennial Averages	1919-24 (6 Yrs)		1925-29		1930-34		1935-39		1940-44		1945-50 (6 Yrs)	
	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%
February	98	5	153	6	183	7	130	5	148	7	83	5
March	212	12	290	12	238	10	352	12	201	10	146	9
April	225	13	400	16	262	11	368	13	279	13	269	18
May	450	25	549	22	529	22	723	25	537	26	354	23
June	318	18	400	16	477	20	601	21	398	19	354	23
July	243	14	369	15	438	18	402	14	305	15	265	17
August	239	13	332	13	291	12	268	10	204	10	83	5
	1,785	100	2,493	100	2,418	100	2,844	100	2,108	100	1,554	100

	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%
April	1	-	-	-	-	-	-	-	-	-	-	-
May	12	1	4	-	14	1	10	1	5	-	2	-
June	428	34	193	20	646	30	571	33	362	33	240	31
July	742	59	701	72	1,341	62	1,024	59	647	58	471	61
August	83	6	70	8	160	7	122	7	97	9	62	8
	1,266	100	968	100	2,161	100	1,727	100	1,111	100	775	100

The Forth

Elie and Kincraig were two netting stations located on the Fifeshire coast of the Firth of Forth. Fishing was discontinued in 1941 and 1940 respectively owing to the heavy estuarial pollution that culminated with the 1939-45 War, during which already inadequate safeguards were relaxed; fishing did not recommence after the War. The catch statistics for the two fishings therefore cover the periods 1900-1941 and 1900-1940 only.

The Forth system enjoyed a considerable winter and early-spring run, at least during the great salmon cycle of the 1920s and 1930s (Menzies observed: "In the Forth district I have seen clean salmon ascending the Falls of Leny on 29th October:" The Salmon, 1931, 94), but the two fishings under review were primarily late spring and summer fisheries, the result of their location low down the Firth. Nevertheless, the two sets of statistics reflect many changes in the return-migration during the forty-plus years period.

During the opening years of the century August was the best month for salmon, and a substantial proportion of the grilse also ran in this month. Over the first two decades the August proportionate catches of both salmon and grilse declined, to be replaced by increased proportions of salmon in the late spring and early summer months, and of grilse during June and July. These movements are analysed in greater detail in subsequent chapters.

Table 71

Numbers of Fish Caught in the Elie Coastal Nets of the Forth District 1900-41

(Source: Joseph Johnston & Sons Ltd., Records.)

Quinquennial Averages	1900-04		1905-09		1910-14		1915-19		1920-22 (3 Yrs)		1926-29 (4 Yrs)		1930-34		1935-41 (7 Yrs)	
	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%
April	21	6	19	5	44	9	29	7	39	4	24	5	23	6	36	6
May	82	21	73	18	109	23	81	20	259	30	116	25	76	18	114	21
June	58	15	76	19	76	16	103	25	302	35	132	28	125	30	155	29
July	89	23	114	29	133	29	117	29	188	21	127	27	145	35	169	31
August	137	35	118	30	104	22	76	19	87	10	65	14	46	11	69	13
	387	100	400	100	466	100	406	100	875	100	464	100	415	100	543	100

	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%
May	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-
June	28	9	40	12	38	12	65	24	70	24	20	14	68	23	68	18
July	161	50	197	58	193	63	173	64	180	62	99	72	194	64	259	70
August	129	41	103	30	76	25	33	12	40	14	20	14	39	13	43	12
	319	100	340	100	307	100	272	100	290	100	139	100	302	100	370	100

Table 72

Numbers of Fish Caught in the Kincraig Coastal Nets of the Forth District 1900-40

(Source: Joseph Johnston & Sons Ltd., Records.)

Quinquennial Averages	1900-04		1905-09		1910-14		1915-19		1920-24		1925-29		1930-34		1935-40 (6 Yrs)	
	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%	Salmon	%
February	-	-	4	1	9	2	5	1	14	2	6	1	15	4	14	2
March	-	-	13	3	37	7	25	5	30	4	26	6	30	7	58	9
April	9	3	27	6	62	12	52	11	35	5	17	4	19	5	40	6
May	51	20	68	15	114	21	87	18	161	23	112	24	66	15	115	18
June	38	15	58	13	83	15	124	26	189	27	108	23	130	30	187	28
July	61	24	134	30	125	23	117	24	172	25	128	28	126	29	183	28
August	98	38	141	32	106	20	72	15	90	13	66	14	43	10	62	9
	257	100	445	100	536	100	482	100	691	100	463	100	429	100	659	100

	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%	Grilse	%
May	1	-	1	-	-	-	1	-	-	-	-	-	1	-	-	-
June	18	7	25	6	23	9	77	29	53	20	11	8	54	18	62	16
July	125	48	245	60	164	64	156	59	166	63	106	77	199	68	268	70
August	115	45	136	34	68	27	31	12	43	17	20	15	41	14	55	14
	259	100	407	100	255	100	265	100	262	100	137	100	295	100	385	100

The Beauly

The overall historical reputation of the Beauly is primarily as a grilse river. The catches do, however, reflect variations by age in the return-migration, as is clear in the two sets of statistics covering 1900-50, as well as in the sets of statistics offered for this river in the two earlier sections of this thesis. Analysis of the angling returns over 1900-50 are provided broken down as between spring and summer catches, as well as between salmon and grilse. The netting catches are available only in the form of total salmon and total grilse quantities.

The salmon run of the Beauly is an early one, the main migration usually being between March and June. Unlike many of the southern rivers this run does not vary very significantly in its seasonal timing at different periods. During cycles when 1SW fish are dominant in the Scottish return-migration the yield of salmon in the Beauly tends to be small in comparison to the numbers of grilse, as may be seen from the statistics for earlier periods.

The combined catches by net and rod indicate the continuing dominance of the grilse that existed in the early years of this century. Thereafter the proportion of salmon in the return-migration gradually increased to reach 54% during 1925-29 as compared to 16% during 1900-04. This marginal predominance of salmon was not maintained thereafter, yet the salmon run remained proportionately strong by the standard of the river right up to 1950.

After allowing for the effects of the changing intensity of netting from time to time, particularly towards the end of the 1920s, it is seen that the grilse run declined to its lowest proportionate

ebb in 1925-29, when it comprised 46% of the total numerical catch, as compared to 84% during 1900-04 which five years marked the tail-end in the Beauly of the decline of the great grilse period of the 1880s and 1890s. As elsewhere, the grilse increased from the 1930 season.

Compared to many rivers on the other hand, particularly those from the Moray Firth southwards, grilse remained reasonably numerous through much of the period, their decline as a percentage proportion of the total catch significantly reflecting the substantial increase of salmon.

(Contd.....)

Table 73

Numbers of Fish Caught by the Nets and Rods Combined in the Lovat Estates Fishings of the River Beauly 1900-49

(Source: Lovat Estates Company, Records.)

Quinquennial Averages	Salmon	%	Grilse	%
1900-04	281	16	1,494	84
1905-09	249	28	638	72
1910-14	664	38	1,091	62
1915-19	448	31	984	69
1920-24	936	46	1,090	54
1925-29	1,441	54	1,241	46 *
1930-34	1,632	44	2,073	56
1935-39	1,355	41	1,922	59
1940-44	1,268	48	1,390	52
1945-49	649	47	731	53

N.B. * More intensive netting commenced in the late 1920s and is believed to have continued through into the war years. Previous to the late 1920s netting is believed to have been carried out only two or three days a week.

Table 74

Numbers of Fish Caught by the Rods Only in the Lovat Estates Fishings of the River Beauly 1900-49

(Source: Lovat Estates Company, Records.)

Quinquennial Averages	Salmon To 31 May	%	Salmon From 1 June	%	Total Salmon	%	Total Grilse	%
1900-04	100	73	37	27	137	40	202	60
1905-09	94	73	34	27	128	53	112	47
1910-14	133	68	62	32	195	55	160	45
1915-19	154	77	46	23	200	70	87	30
1920-24	171	70	75	30	246	62	151	38
1925-29	163	71	66	29	229	71	93	29
1930-34	122	58	88	42	210	71	84	29
1935-39	121	64	68	36	189	61	119	39
1940-44	126	68	59	32	185	53	161	47
1945-49	122	71	51	29	173	59	118	41

The Spey

The statistics in Table 75 are the catches of salmon and grilse at the Raik fishery, which was the principal net fishing of the Spey river and coastal district. They comprise the produce of four stations, two inside the river mouth (the Spey has no estuary) and two on the coast, respectively east and west of the mouth. The stations are fished at different times of the season according to the run, the river stations being both spring and summer fishings and the coastal stations being essentially summer fishings that make large

catches of trout and also, sometimes, good catches of salmon and grilse.

The catches 1900-50 have been divided as between salmon and grilse and the salmon catch has been sub-divided, as at 31st May, into spring and summer fish (general indication only). This latter division contains, within the summer catch, a latent ambiguity that exists to some degree in many of the statistics of this section, resulting from the nets catches of June to August being classed together, and which is particularly marked in the Spey. This ambiguity results from the fact that, as the late-summer proportionate catch declined after the first decade of the fifty-year period, the early-summer catch tended to increase, this relationship particularly affecting the catches of August and June respectively, of which more in this and later chapters.

The grilse catch held up more or less consistently over the fifteen years 1900-1915, followed by a rapid decline during 1916-20 leading to a dearth during 1926-30. From 1930 the run registered a modest improvement, sustained during the subsequent decade, but during the 1940s the run once again faded, particularly in the last quinquennial period.

As regards salmon, the first fifteen years 1900-15 demonstrate a consistency in the catches of about 50% spring fish and 50% summer fish (based on a division at the end of May). During the subsequent quinquennial period there was a decline of summer fish, that became proportionately marked after 1921, from which date there was a considerable absolute increase of spring fish in the catches.

Perhaps it should be pointed out that the proportions of spring

fish in the catches of 1900-05 are artificially enhanced in a comparison with the spring catches thereafter. It was the practice during the early years of this century (as during last century) to net the fresh-water pools for several miles up the river, a practice that was subsequently terminated, it is believed at the end of the 1903 season. This netting particularly increased the February catches since at the opening of the netting most of the fish that had gathered over the winter in the fast-flowing pools of lower Spey were swept up, whereas after this form of river netting ceased this early stock was preserved for the sportsmen.

During the first two decades the nets' catches tended to be spread out over the season from February to August. During the thirty years 1920-1950 the main nets' catches of salmon were usually made in May and June, often extending to the end of the first week of July when the main run and catch usually came promptly to a stop. The February and March nets' catches were not usually heavy. The May nets' catch (which was specially abstracted in percentage form only by the writer in connection with an angling interest) as a proportion of the whole amounted to 15.6% average for the five years 1900-1904 as against 30.7% average for the five years 1946-50. Owing to limitation on time the June nets catch was not abstracted separately in the same manner but the proportionate increase in the catch during this month over the fifty years was certainly as marked as that of May, if not more so.

The rod angling of the Spey between 1921-1950 was particularly famous during April and May, but not during February and March, except in the bottom reaches of the river. This has partly to do with the

fact that the lower Spey is very fast-flowing and, combined with the cold water of the winter season, the run through the river was held back until April; but also it undoubtedly has to do with the fact that the main spring run in the Spey was not so early as in Dee, Tay and Tweed. There is, therefore, much constructive evidence that the main salmon runs into the Spey during 1920-1950 took place during April, May and June, the nets beginning to catch particularly well usually during May when the water dropped.

The massive decline of grilse in the Spey between the 1880s and the 1920s is hardly reflected by the nets catches from 1900 alone, since there was a plateau between 1900 and 1915. Information offered later gives some indication of the dramatic scale of that decline.

Table 75

Numbers of Fish Caught in the Raik River and Coastal Net Fishings of the River Spey 1900-50

(Source: Gordon Richmond Fishings, Records.)

Quinquennial Averages	Salmon Feb-May	%	Salmon June-Aug	%	Total Salmon	% Total Catch	Grilse	% Total Catch
1900-05 (6 years)	2,366	52	2,199	48	4,565	46	5,424	54
1906-10	2,225	52	2,084	48	4,309	42	5,917	58
1911-15	2,774	51	2,635	49	5,409	47	6,155	53
1916-20	2,309	66	1,168	34	3,477	58	2,512	42
1921-25	3,218	63	1,875	37	5,093	65	2,724	35
1926-30	2,456	65	1,351	35	3,807	70	1,664	30
1931-35	3,151	64	1,762	36	4,913	61	3,184	39
1936-40	5,351	72	2,091	28	7,442	71	3,096	29
1941-45	1,381	44	1,747	54	3,128	54	2,714	46
1946-50	2,046	63	1,221	37	3,267	62	2,054	38

Tweed

The Berwick Salmon Fisheries Co., the main netting proprietors on the Tweed, would not permit access to their records 1900-1950. Consequently a picture of the return-migration over the fifty-year period has had to be constructed for this river using a variety of other sources, both net and rod.

First, the Appendices to the Fishery Reports for Scotland over 1903-1914 inclusive provided a breakdown of the annual salmon and grilse combined catches, in the form of percentage catches of each month throughout the season for nets and rods separately. The Reports for the two years 1903 and 1904 offered percentages only in respect of the lower river sweep nets, which constituted the main numerical source of fish, but from 1905 details were also provided of the catches made by the district coastal nets and by the rods. Since the coastal nets did not begin to fish until June they are omitted, on the grounds that without actual numbers of salmon and grilse the percentages for a part-season fishery are not meaningful. Table 76 (a) and (b) summarise the percentage numerical catches by year and season for the sweep nets and rods respectively. The netting season was 15 February to 14 September, and the rod-fishing season 1 February to 30 November:-

Table 76

Numerical Percentages of Fish Caught in the River Tweed 1903-14

(Source: Reports of the Fishery Board for Scotland, 1903-14, Appendices.)

(a) Tidal and Lower River Sweep Nets Catches

	% 15 Feb - 31 May	% 1 June - 14 Sept
1903	12	88
1904	19	81
1905	24	76
1906	18	82
1907	16	84
1908	19	81
1909	12	88
1910	19	81
1911	25	75
1912	22	78
1913	26	74
1914	36	64

(b) Rod Catches

	% 1 Feb - 31 May	% 1 June - 30 Sept	% 1 Oct - 30 Nov
1905	16	6	78
1906	14	10	76
1907	6	6	89
1908	12	8	81
1909	12	3	85
1910	6	4	90
1911	42	1	55
1912	18	7	75
1913	31	4	64
1914	55	7	38

For both nets and rods catches the spring fish percentage began to increase markedly from 1911. The particularly noticeable proportionate increase in the rods catches for the spring months from 1911 as compared to the nets is a reflection of the importance of a good winter and early-spring run for productive rod fishing.

As a result of economies necessitated by the Great War the analysis terminated after 1915 (i.e. covering the 1914 season) and was not recommenced after the war.

No division between salmon and grilse is available in respect of the summer-autumn periods of Tables (a) and (b). However, the separate salmon and grilse catches of two coastal nets in the Tweed district over broadly the same period were:-

Table 77

Numbers of Fish Caught by the Lamberton and Marshall Meadows and the Redhaugh Coastal Nets of the River Tweed District 1898-1916

(Source: Joseph Johnston & Sons Ltd., Records.)

	Salmon	%	Grilse	%
Lamberton and Marshall Meadows Nets 1902-1916				
1902-1906	703	54	596	46
1907-1911	692	64	383	36
1912-1916	818	69	365	31
Redhaugh Nets 1898-1914				
1898-1902	960	47	1,088	53
1903-1907	888	50	882	50
1908-1914 (7 yrs)	896	56	718	46

Records of two quality river rod fisheries for the full fifty years 1900-1950 come by courtesy of Dr. Derek Mills of Edinburgh University's Department of Forestry and National Resources. This information was made available by the riparian proprietors for publication on the understanding that anonymity would be preserved so the sources cannot be identified. One record is numerical; the other is in the form of graphs without scale. Both compare the spring with the autumn catches:-

Table 78

Numbers of Fish Caught in a Lower River Rod Fishery of the Tweed 1901-1950

(Source: Confidential)

Quinquennial Averages	Spring (Feb to May)		Autumn (June to Nov)	
	No.	%	No.	%
1901-1905	16	21	59	79
1906-1910	18	26	51	74
1911-1915	58	51	55	49
1916-1920	75	55	62	45
1921-1925	138	70	59	30
1926-1930	160	67	79	33
1931-1935	287	82	65	18
1936-1940	422	86	66	14
1941-1945	292	78	81	22
1946-1950	325	91	32	9

The spring catches began to increase significantly 1911-1915; continuing to increase until the 1930s. It is known that by the early 1920s big runs of fish were migrating into the river during the winter months, before the netting commenced on 15 February. It might be misleading to assume that the big increase in spring catches during the 1930s as compared to the 1920s was due solely to a proportionate increase in the quantities of salmon running. An important contributory cause may have been that the run became earlier, and more fish arrived before the start of netting and were therefore accessible to the rods. Another possible contributory factor might have been the staging of the spring run in the river. Although difficult to monitor scientifically it is known that staging habits of the spring run favour some beats as against others, and vary in many rivers, including the Tweed, from period to period, independent of valid water temperature considerations (i.e. spring salmon tend to run slower in cold than in warm water). During the 1930s and 1940s the slow-running habits of the spring fish in the lower Tweed were notorious among anglers.

The consistency of the autumn catches, albeit at a modest level, does not necessarily reflect varying numbers of summer-autumn fish running at different periods over the fifty years. If the rod fishery under discussion is located not far above tide-limit it may be a rather poor autumn beat at all periods, but potentially a good spring fishing when plenty of early fish are running. This is because the river water temperature in the autumn is usually much higher than during the later winter and early spring, and the fish run through. The best autumn rod fishings in the Tweed tend to be higher up-river

than the best spring fishings. The graphs for the second rod fishing provide, it is believed, a much more realistic assessment of the decline of the autumn run and fishing after 1900 in the Tweed generally.

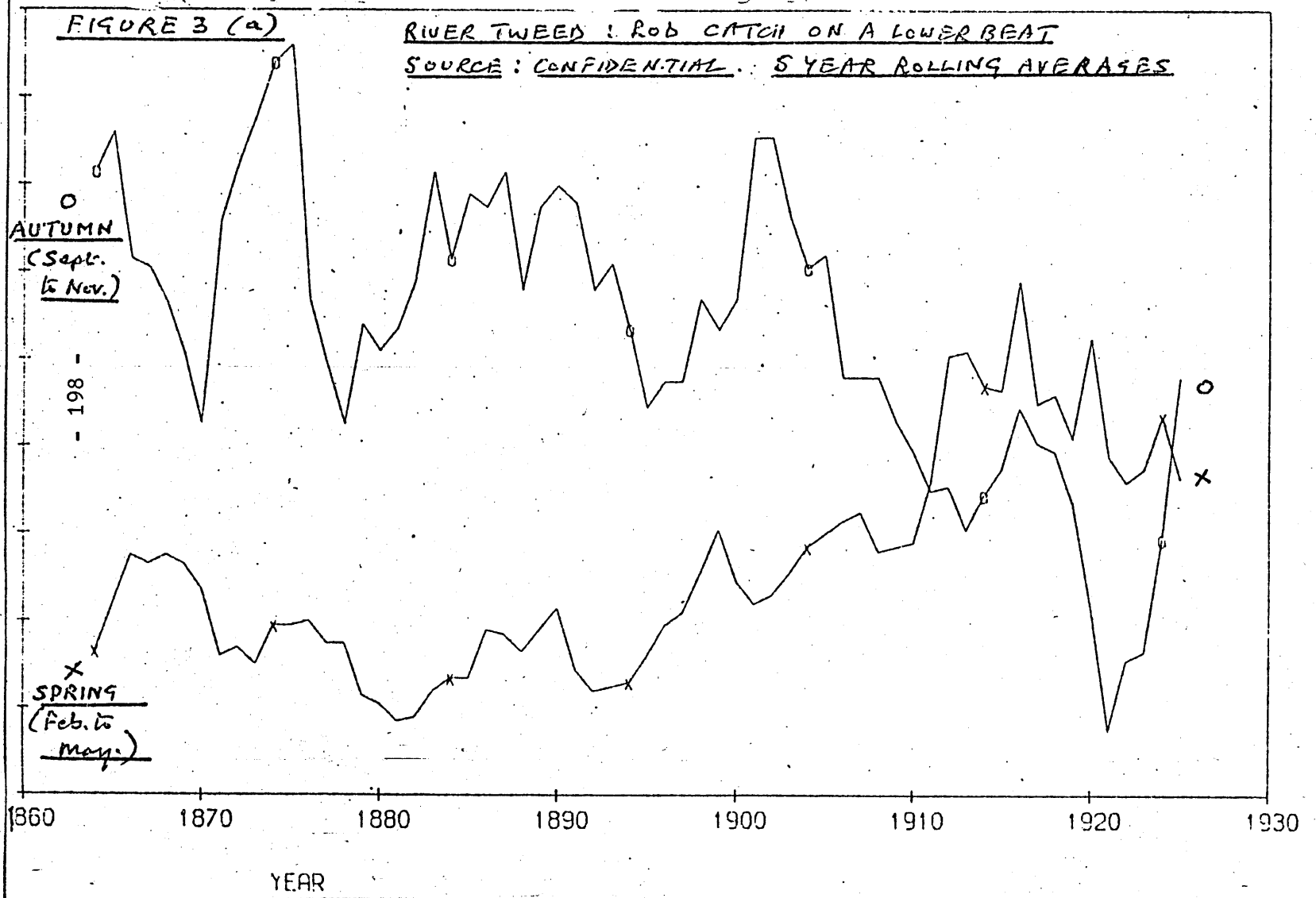
Figures 3(a) and (b) cover the two periods c.1864 to c.1925 and 1934-1950, on a second Tweed rod fishing. The two graphs are to different scales, in view of the large number of spring fish caught between 1930 and the early 1960s as compared with the earlier period. The figures are plotted as the five-year rolling average of the catches in the spring (February to May) and the autumn (September to November) each year. The spring lines are marked X and the autumn lines O.

(Contd.....)

FIGURE 3 (a)

RIVER TWEED : ROD CATCH ON A LOWER BEAT

SOURCE : CONFIDENTIAL . . 5 YEAR ROLLING AVERAGES



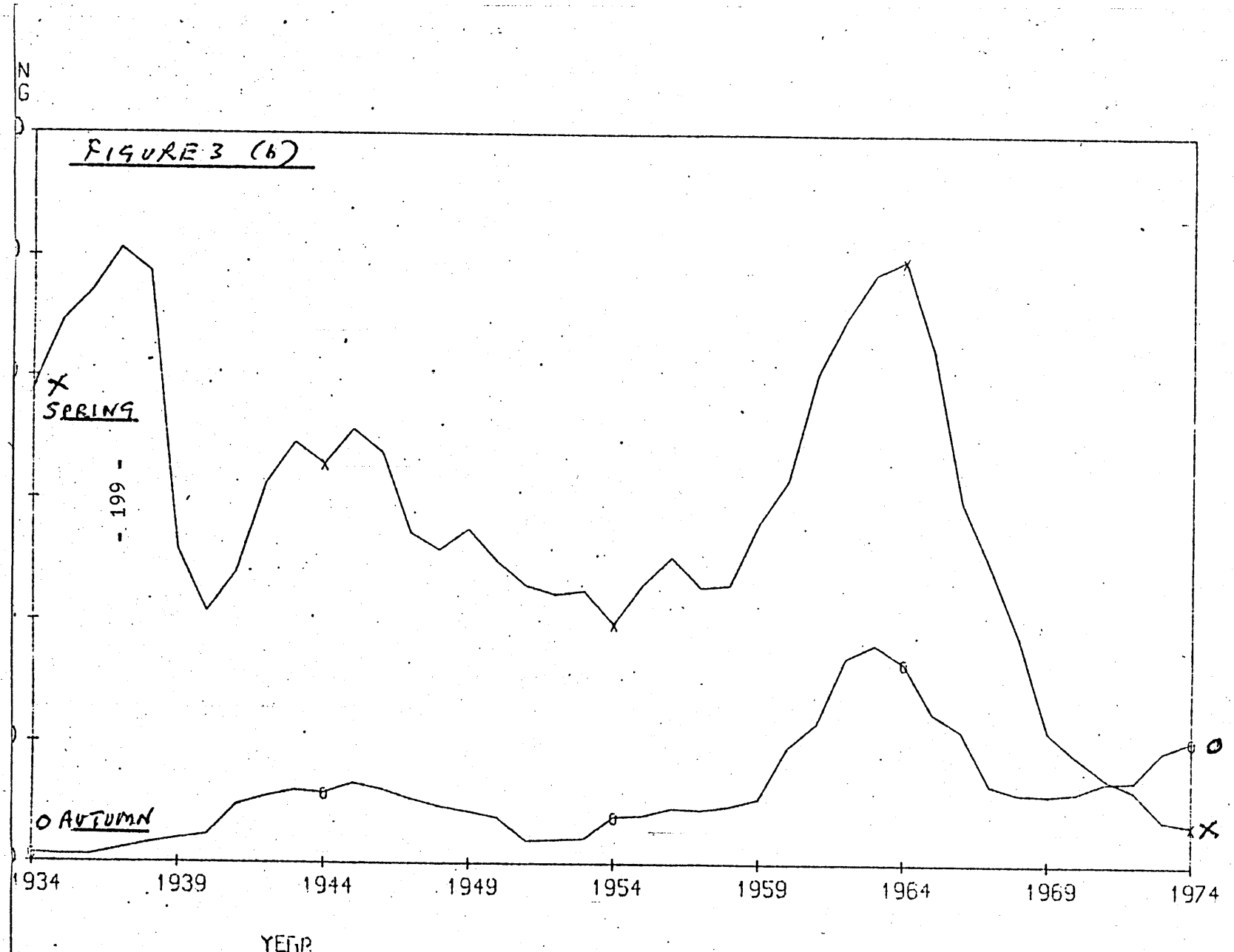


FIGURE 3 (b)
X SPRING
O AUTUMN
- 199 -
1934
1939
1944
1949
1954
1959
1964
1969
1974
YEAR

There was a marked increase of the spring catch early in the century, and particularly from about 1911. The autumn catch correspondingly entered into a more or less continual decline from the opening decade of the century, reaching a nadir during the 1930s, a factor that may corroborate the earlier statement that by the 1930s the salmon run as a whole had become earlier.

Detailed investigations into the Tweed migration were carried out by the Inspectorate of Salmon Fisheries of Scotland during the seasons of 1929 and 1930, and a comparison of the 1929 salmon run (excluding grilse) with the 1930 salmon run may highlight a crucial distinction between the nature of the run during the 1920s and that of the 1930s:-

Table 79

Analysis of 2SW Fish in Netting Catches of River Tweed 1929 and 1930 Seasons

(Source: Fisheries, Scotland, Salmon Fish, 1932 No. 111, 1933 No. 111.)

	1929		1930	
	2SW	2 + SW	2SW	2 + SW
February (from 15th)	4.0	-	8.3	-
March	25.6	-	37.9	-
April	24.4	-	23.9	1.1
May	34.2	5.7	27.2	15.8
June	10.4	17.7	2.4	26.9
July	1.4	28.4	0.3	35.6
August	-	29.6	-	13.7
September (to 14th)	-	18.6	-	6.9
	100.0	100.0	100.0	100.0

In the Tweed the salmon stock is comprised overwhelmingly of 2SW/2+SW fish; therefore, the salmon run as a whole became considerably earlier in 1930 than in 1929. That 1930 may have marked a crucial stage in the development of the Tweed early run is, perhaps, supported by comment in the 1929 investigation about the general nature of the salmon run at that date: "The Tweed is perhaps the best example in Scotland of a river in which the qualities of both an early and a late fishing are combined.... from July onwards to the end of the netting season the summer run continues at a high level...." (p.6). In 1930 the salmon run was substantially over by the end of July.

The increase of the grilse run in the 1930 season, so general in the statistics of this section, was conspicuous in the Tweed nets catch analysis:-

	S.W.	1+	2	2+	3	3+	4	Spawning Mark	Total
1929	%	6.6	34.9	50.9	4.2	0.9	-	2.5	100.00
1930	%	46.37	24.05	23.3	3.3	1.48	0.02	1.48	100.00

(Ibid., 1932, 1933.)

The Aberdeenshire Dee

The Aberdeenshire Harbour Board, the principal netting proprietors, has provided details of all salmon and grilse caught in their nets on the Aberdeenshire Dee over the period from 1872, when their formal statistics begin, until 1950. The statistics are in the form of total salmon and total grilse caught each season, together with average weights of salmon and grilse. The catches are not broken down by month or into spring and summer. Fortunately, the salmon

catches are divided into those caught in the sea nets at the mouth of the river and those caught in the river nets that are located upstream in the tidal part of the river. Separate average weights are given in respect of salmon from the sea nets and salmon from the river nets.

All these factors enable deductions to be made about the return-migration and its variations by age and season during the fifty years 1900-1950. Normally, discussion of the fish weights would be deferred until the relevant sectional chapter on weights, but, in the absence of a breakdown of the salmon catch, the salmon weights are needed to form a picture of the return-migration. Similarly, the statistics 1872-1900 are incorporated to develop the argument as to the nature of the salmon run 1900-1950. (Consideration of the average grilse weights - as opposed to salmon - are, however, delayed until the relevant chapter.)

Information offered to support the ensuing argument is incorporated into Figure 4 and Tables 80 and 81.

Figure 4 comprises a graph in which the four separate plotted lines are for total grilse, salmon caught in the sea nets, salmon caught in the river nets, and total salmon (being the sum of the sea and river nets).

Table 80 gives the mean weights of salmon caught respectively in the sea nets and the river nets for five year periods between 1872-1950.

Table 81 gives salmon and grilse catches by month over the five years 1921-25 in the Aberdeen Harbour Board nets. (This information has been abstracted from various scientific papers published in the

1920s and 1930s and is quite separate from the information provided by the Harbour Board.)

(Contd.....)

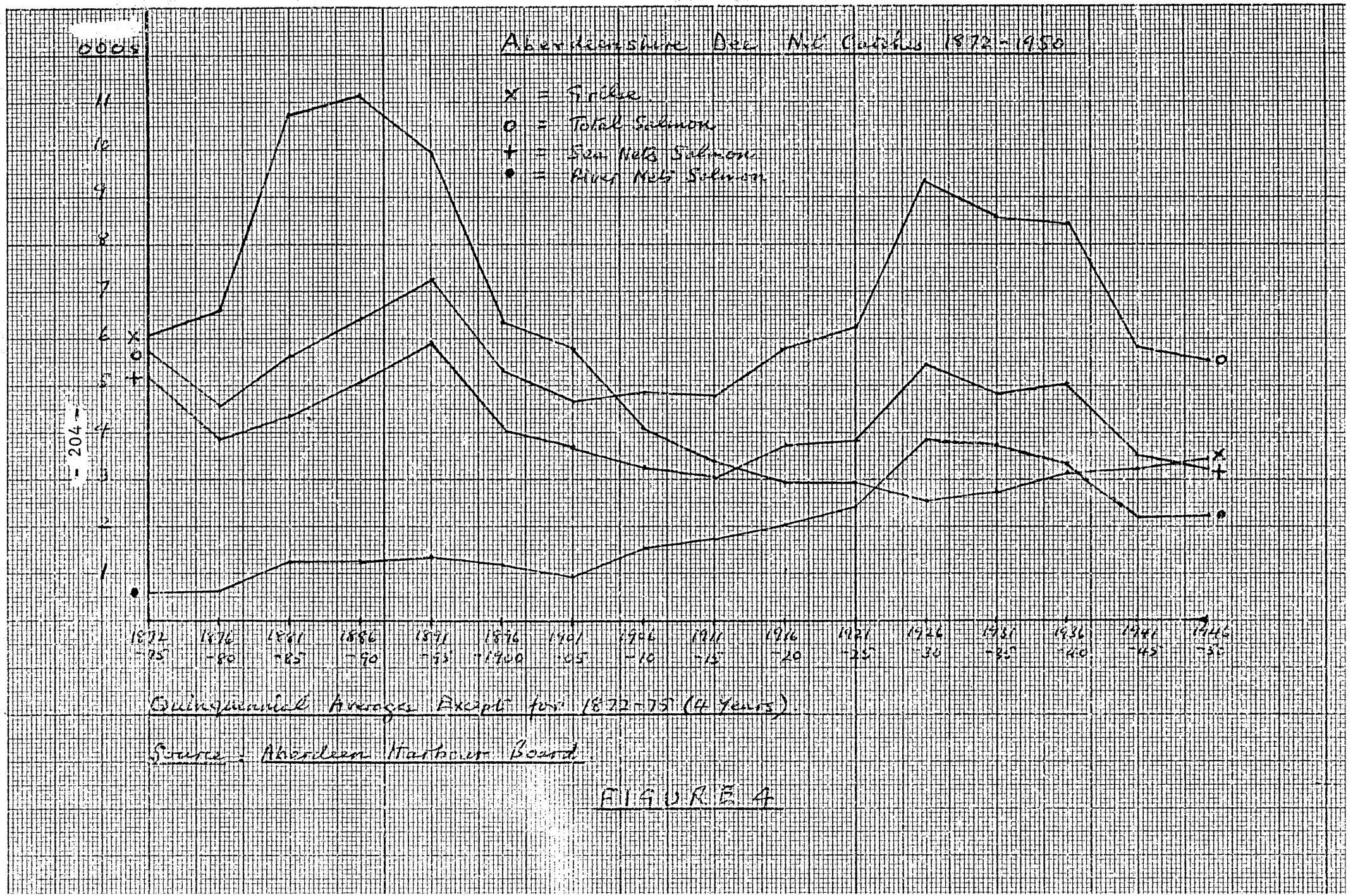

Aberdeenshire Dee N.E. Coast 1872-1950
000's
X = Rod
O = Total Salmon
+ = Sea Run Salmon
• = River Run Salmon
12
11
10
9
8
7
6
5
4
3
2
1
1872 -75
1876 -80
1881 -85
1886 -90
1891 -95
1896 -1900
1901 -05
1906 -10
1911 -15
1916 -20
1921 -25
1926 -30
1931 -35
1936 -40
1941 -45
1946 -50
Quinquennial Averages Except for 1872-75 (4 Years)
Source: Aberdeen Harbour Board.

FIGURE 4

Table 80

Analysis of Salmon Caught in the Sea and River Nets of the Aberdeen Harbour Board in the Aberdeenshire Dee 1872-1950

(Source: Aberdeen Harbour Board, Records.)

Quinquennial Averages	Salmon - Sea Nets			Salmon - River Nets		
	Av. Annual No.	% of Total Catch	Av. Annual Weight (lb)	Av. Annual No.	% of Total Catch	Av. Annual Weight (lb)
1872-75(4 yrs)	5,112	(89)	11.61	600	(11)	9.69
1876-80	3,865	(86)	12.42	651	(14)	9.80
1881-85	4,387	(77)	10.93	1,276	(23)	9.31
1886-90	5,142	(80)	10.79	1,273	(20)	8.90
1891-95	5,918	(81)	11.02	1,371	(19)	9.21
1896-1900	4,164	(78)	11.63	1,169	(22)	9.05
1901-05	3,745	(80)	10.83	943	(20)	8.89
1906-10	3,291	(68)	10.27	1,536	(32)	8.70
1011-15	3,026	(63)	10.61	1,742	(37)	9.01
1916-20	3,770	(65)	10.02	2,037	(35)	9.05
1921-25	3,845	(61)	10.72	2,426	(39)	10.18
1926-30	5,465	(58)	10.41	3,882	(42)	10.00
1931-35	4,862	(57)	10.70	3,721	(43)	10.69
1936-40	5,034	(60)	10.47	3,380	(40)	10.44
1941-45	3,667	(62)	10.86	2,212	(38)	10.37
1946-50	3,267	(59)	10.30	2,277	(41)	10.15

Table 81

Analysis of Salmon and Grilse Caught in Sea and River Nets of the Aberdeen Harbour Board in the Aberdeenshire Dee 1921-25

(Sources: Fisheries, Scotland, Salmon Fish, 1921 I (June 1922); Ditto 1924 III (October 1924); 1926 IV (Sept. 1926); 1927 III (Oct. 1927); 1931 IV)

	1921	1922	1923	1924	1925
		SALMON			
February	2,588	959	845	2,110	2,636
March	1,674	784	1,177	2,094	2,614
April	999	759	801	2,325	1,444
May	765	438	606	858	811
June	429	145	429	432	288
July	125	296	267	219	106
August	155	537	212	301	127
	6,735	3,918	4,337	8,339	8,026
		GRILSE			
February	-	-	-	-	-
March	-	-	-	-	-
April	-	-	-	11	-
May	29	36	19	149	38
June	1,794	844	1,253	2,173	2,038
July	885	1,328	1,194	986	1,345
August	13	170	52	240	66
	2,721	2,378	2,518	3,559	3,487

By the early 1920s the main salmon run was a winter-early spring one and that the run began to decline after March or April. The main grilse run usually occurred in June and early July.

Figure 4 demonstrates clearly the great grilse period of 1881-1896, and the subsequent gradual decline of the grilse to a nadir during 1926-30, following which period there was a very gradual recovery. The corresponding increase of salmon from 1916-20 is also conspicuous, reaching a climax during the 1920s and 1930s.

It is the dichotomy of the salmon sea nets' catches and the salmon river nets' catches, considered together with variations in the average weights of salmon caught in the two sets of nets, that enables a construction to be placed on the timing of the salmon run.

It is widely recognised as a general characteristic that sea and lower-estuary nets tend to catch proportionately greater quantities of summer fish, whereas river nets tend to catch proportionately greater quantities of spring fish. The reason for this is that in Scotland there are normally high river levels during the spring months until May and the fish are drawn quickly from the sea into the estuary and the river. In the summer, on the other hand, low water conditions normally prevail for long periods, with the result that the coastal and lower-estuary nets (which is really what the Aberdeen Harbour Board's "sea" nets are) catch better than the lower river nets.

In applying this general principle to the Aberdeenshire Dee Figure 4 shows that from 1872 until 1906-10 the sea nets caught far more salmon proportionately than the lower river nets, but that progressively from 1906-10 until 1926-30 the river nets continued to improve their catches.

Table 80 shows that the average weight of the salmon caught in the sea nets was markedly higher at the opening of the period, from

1872, than the average weight of the salmon caught in the river nets. The most likely reason for this in a river such as the Dee, where the salmon stock is overwhelmingly of the 2/2+SW class, is that the sea nets catch higher proportions of late-spring and summer 2 + SW salmon, whereas the river nets catch higher proportions of early spring 2SW salmon of lighter average weights.

The average weight of salmon caught in the sea nets continued to be greater than the average weight of salmon caught in the river nets throughout the entire period 1872-1950, but progressively, and particularly from 1906-10, the gap narrowed until, by the 1930s, the two average weights were virtually identical.

It is believed that all these factors conspire to indicate that:

(i) From 1916-1920 the salmon run rapidly increased.

(ii) From 1906-10 the salmon run gradually became earlier, until by the 1930s the sea and the river nets were catching virtually the same class of fish: almost entirely spring fish, largely of 2SW age. That this was the case is supported by the statistics of Table 81, relating to the five years 1921-25, which evidence how early the main salmon run in the Dee had become by the early 1920s. The seasons of 1921, 1923, 1924 and 1925 should be taken as typical of the period. The 1922 season, with its considerable late-summer run, was a throw-back to the opening decade of the century. (This substantial 1922 late-summer run was evident in the salmon statistics of many other rivers used in this section.)

Further weight analysis on both salmon and grilse is provided later.

The Thurso

This small but famous river was preserved largely for the benefit of salmon fly fishermen over the period 1900-50. Annual rod catches are available from 1922, and are presented by the month in Table 82.

The rod catches demonstrate the dominance of the spring run throughout the twenty-nine year period, the two months of April and May accounting for nearly 50% of the total catch, the late March and early June catches often also being significant, particularly in seasons with a strong migration.

These statistics are of limited use by themselves but become more relevant when compared to the rod-catch numerical statistics for the Thurso over 1951-76 in Section IV, which display the influence of vastly increased summer runs.

(Contd.....)

Table 82

Rod Catches of Salmon and Grilse in the River Thurso 1922-50

(Source: Records of the Thurso Estates Company.)

Quinquennial Averages	1922-25 (4 Yrs)		1926-30		1931-35		1936-40	
	No.	%	No.	%	No.	%	No.	%
Jan	4	1	7	1	2	-	1	-
Feb	20	3	28	3	15	2	16	3
Mar	110	14	92	10	78	11	58	13
Apr	172	22	196	22	225	32	157	34
May	181	23	188	21	145	20	72	16
June	73	9	149	16	77	11	37	8
July	48	6	34	4	29	4	33	7
Aug	51	6	51	6	25	4	29	6
Sept	95	12	126	14	79	11	48	10
Oct (to 7th)	32	4	38	4	21	3	10	2
	786	100	909	100	696	100	461	100

	1941-45*		1946-50	
	No.	%	No.	%
Jan	-	-	1	-
Feb	2	-	6	1
Mar	11	3	48	9
Apr	109	34	123	23
May	57	18	123	23
June	26	8	33	6
July	37	12	30	6
Aug	22	7	28	5
Sept	31	10	97	18
Oct	24	8	39	7
	319	100	528	100

* 4 years only 1945 not fished.

3. Summary of Conclusions about the Return-Migration 1900-1950

The principal conclusions to be drawn from these catch statistics are:-

As regards salmon: During the second decade of the century there was a remorseless decline of late summer-running salmon concomitant with a rapid increase of early-running salmon. These enhanced runs of early fish attained their zenith during the 1920s and 1930s. For a few seasons in the mid-1940s the return-migration as a whole deteriorated to a low level, but by the last three years of the period 1948-1950 the run of salmon was resuscitated and they were still substantially early-running compared to the opening years of the century.

As regards grilse: Following a great and quite sudden decline of the run in the 1890s the quantities of grilse tended to be sustained at a comparatively reduced level, or at least to continue to decline at a much slower rate, in most districts until varying dates between 1915 and 1925. At this period the run in general became reduced in most seasons to a very low ebb by known historical standards. In 1930 there was a partial recovery that was sustained in a number of seasons during the subsequent decade, but the run again slumped during the 1940s and continued so to the end of the period.

M ore detailed descriptions of these events are provided subsequently.

4. The Continuing Decline of the Grilse

In section II it was shown that the grilse run experienced a resurgence in many seasons between 1881 and 1895, entering

upon an immediate decline after the latter date.

From the turn of the century this attenuated grilse run tended to continue to decline at a much slower rate until the second decade of the century, varying from district to district, from which time the numbers of grilse once more declined sharply until the run had become small according to any available basis for historical comparison. The reduction in total numbers caught to fewer than the numbers of salmon had occurred in some districts by 1915-19; in others the decline was staged over three quinquennial periods; yet in others it was substantially delayed until 1925-29, but by the second half of the 1920s the grilse run in general had reached a very low ebb indeed. This picture is reflected by the statistics of all the catches provided.

Whilst the statistical evidence is not overwhelming there is also considerable information available from both the catches and the written river reports of the period that the grilse as a whole tended to migrate rather earlier in the summer from 1915-1920 as compared to the opening decade of the century. There may be a further presumption associated with this development, which is discussed later, that the grilse average weight tended to decline from 1915-19 until towards the end of the period.

The trend to earlier-running grilse is demonstrated by the Forth, the North Esk and the South Esk statistics, and was noticed in the Spey grilse catches when they were collated (but owing to shortage of time not recorded by the month). That is to say, instead of peaking during the latter part of July and continuing strong into August, the run began to peak, from 1915-19, early in July in some

rivers, following good runs late in June. In other rivers, July became the primary grilse month, instead of July and August. During the opening decade 1900-1909, August had sometimes produced more grilse than July in the Elie catches of the Forth: during 1900-04 41% of grilse were taken in August; during 1905-09 30%; during 1910-14 25%, declining to 12% during 1915-19, and the August grilse catch did not vary significantly from this last percentage until the Elie fishing terminated in 1941. The grilse run declined and became earlier at about the same time that the salmon run increased and tended to become earlier.

The August grilse catch of the Kincraig fishery in the same district declined from 45% 1900-04 to 34% 1905-09, 27% during the subsequent quinquennial period to 12% during 1915-19. Thereafter until 1940 it varied between 14 and 17% of the total grilse catch. At the Kirkside fishings of the North Esk District a similar but less steep decline for August grilse was recorded from 21% in 1900-04 to 5% over the seven years 1915-21; and at the Rossie fishings of the South Esk from 25% during 1900-04 to 8% over 1925-29.

The decline of the August grilse was reflected not only by an increase in the July proportions of total grilse caught, but particularly by the June proportions:-

Table 83

Percentages of Total Grilse Catches Made in June

(Source: Joseph Johnston & Sons Ltd., Records.)

		1900-04	1915-19
Forth:	Elie	9%	24%
Forth:	Kincraig	7%	29%
North Esk:	Kirkside	19%	40%

In other words, the grilse run had become earlier. A logical corollary of this would be a significant reduction in the average weight of the grilse by 1915-19. Detailed average weights for the Forth and North Esk fishings are not available. On the other hand, detailed average weights (though not numerical catches by the month) are available for the Aberdeenshire Dee 1900-20 and these demonstrate a conspicuous decline of average weight over 1915-1920 as compared to the opening years of the century. The Dee grilse run was earlier during 1921-25 than it had been 1894-1900.

The June proportions of the total grilse catches were not generally so great after 1915-19 as during that quinquennial period, but still much higher than during 1900-04. During the improved grilse seasons of the 1930s July was conspicuously the principal month for the grilse return-migration, as reflected by the netting returns, in many of the east coast districts.

The great decline of the grilse between the 1880s and 1915-1919 is partly obscured by being divided between two sections of the thesis. To bring it into relief some Spey and Dee grilse catches are given in Table 84. The Spey catches are available only over the twenty six

years 1887-1912 inclusive, and therefore terminate before the beginning of the further great grilse decline during 1916-20 so evident in the statistics of the Raik fishery.

Table 84

Spey Grilse Catches 1887-1912

(Source: Gordon Richmond Fishings, 1887-1912)

Quinquennial Averages	Nos. of Grilse
1887-91	29,637
1892-96	24,932
1897-1901	14,449
1902-06	12,469
1907-12 (6 years)	10,384

Aberdeenshire Dee Grilse Catches in the Nets of the Aberdeen Harbour Board 1884-1918

(Source: Report of the Fishery Board for Scotland, 1920, Appendices, 138.)

Quinquennial Averages	Nos. of Grilse
1884-88	11,718
1889-93	9,346
1894-98	8,137
1899-1903	6,157
1904-08	4,696
1909-13	4,113
1914-18	2,238

Much further north the percentage proportion of grilse in the catches of the Crosskirk fishing in the Pentland Firth during the eleven-year period 1910-1920 were:

Table 85

Percentage Proportions of Grilse Caught in the Crosskirk Fishing of the Pentland Firth 1910-20

(Source: Report of the Fishery Board for Scotland, 1920, Appendices, 138.)

Year	% Grilse	Year	% Grilse
1910	76	1916	53
1911	76	1917	58
1912	72	1918	58
1913	63	1919	68
1914	47	1920	38
1915	70		

In the season of 1930 there occurred a general increase of grilse, modest by the standard of the 1880s but significant by the standard of the 1920s. This improved grilse run was sustained during many seasons of the ensuing decade, as can be seen in the earlier statistics. But during the decade of the 1940s the grilse run once again deteriorated to a low level, particularly from the middle years of the decade, the final quinquennial period 1946-50 yielding catches almost as depressed as those of 1925-29.

The fortunes and fluctuations of the grilse fishing being of such importance to the commercial salmon fisheries, in 1935 the Scottish Salmon Inspectorate obtained grilse catches for the whole period 1900-1934 from several important (but unnamed because

confidential) fishings on the east coast, lying between Berwick and Cairnbulg Point at the entrance to the Moray Firth. Reproductions of the graphs constructed from these catches are given in Figures 5 and 6. In general they evidence the decline of grilse early in the century until the decrease bottomed out at various stages between 1915-19 and 1925-29. A general improvement is indicated for the period 1930-34. (Report of the Fishery Board for Scotland, 1934, 68-9.)

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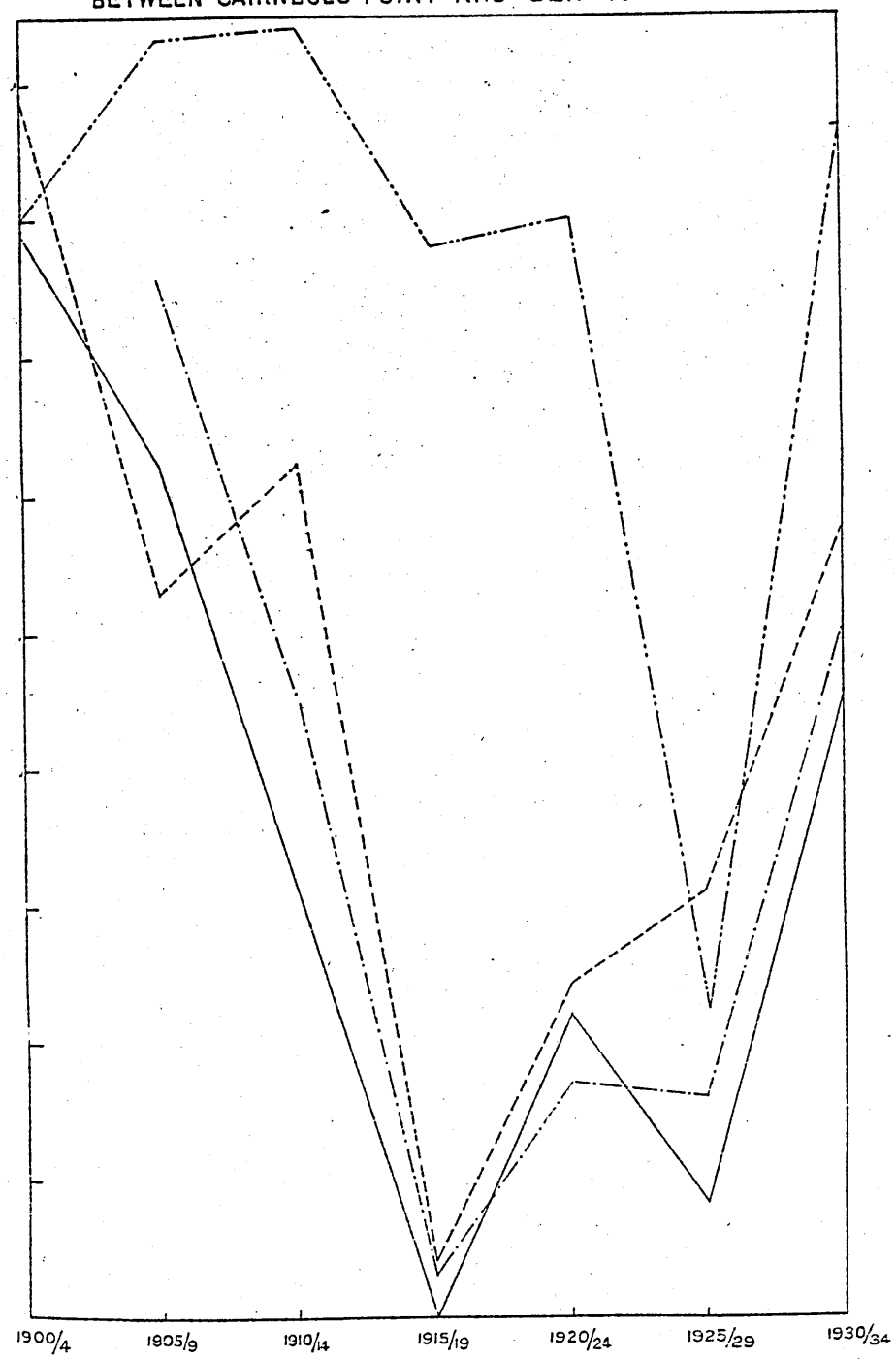
FIGURE 5

QUINQUENNIAL AVERAGE CATCHES OF GRILSE IN FISHINGS BETWEEN CAIRNBULG POINT AND BERWICK-ON-TWEED.



QUINQUENNIAL PERIODS.

Source: Fishery Board for Scotland, Annual Report 1934.

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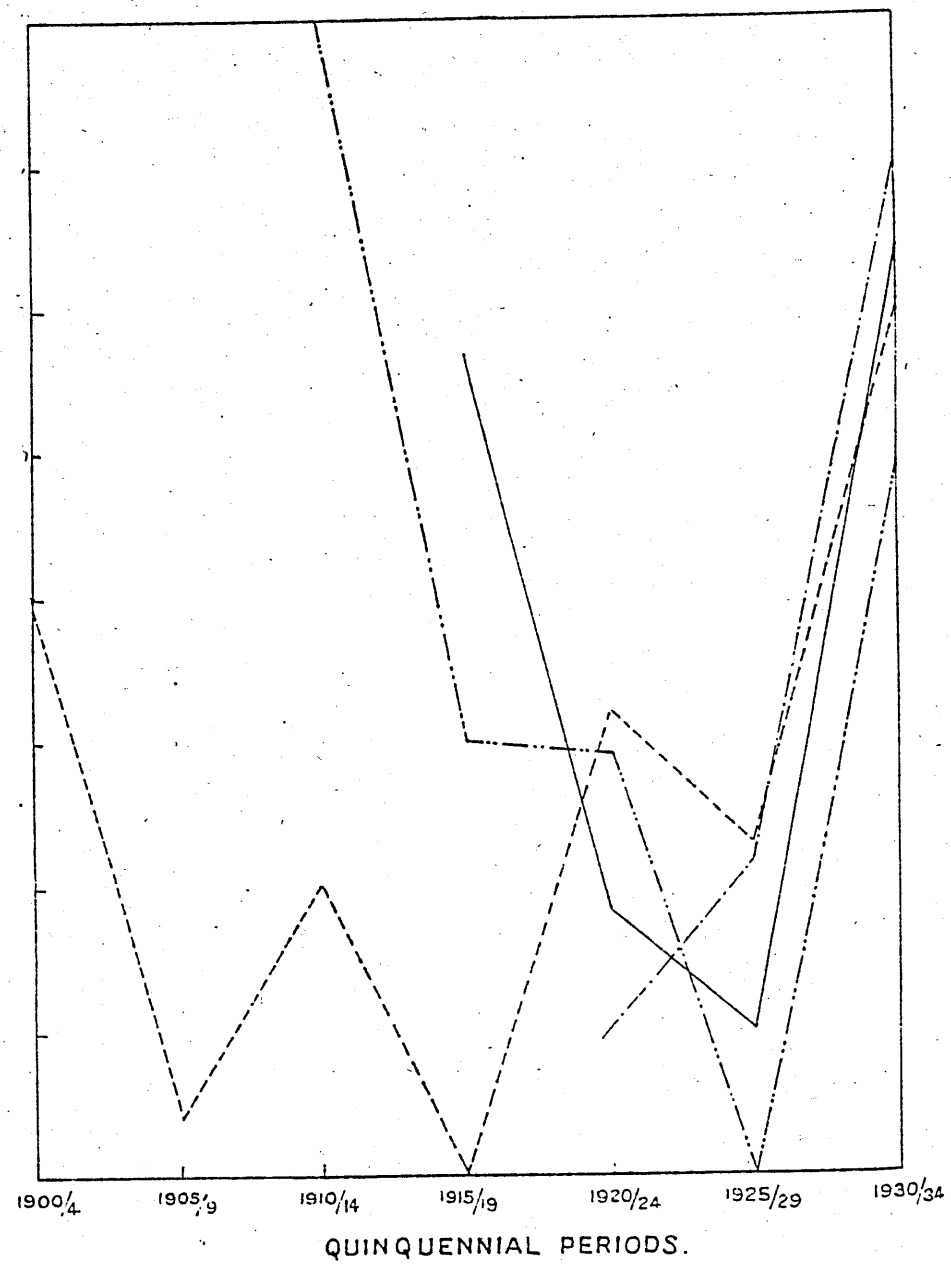
FIGURE 6

QUINQUENNIAL AVERAGE CATCHES OF GRILSE IN FISHINGS IN THE MORAY FIRTH AREA.



Source: Fishery Board for Scotland, Annual Report, 1934.

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5. The Decline of Late-Summer Salmon

The decline of the run of 2 + SW and older salmon in the nets catches during the later summer (the "autumn" run of the salmon angler) was a feature of the opening period of this section, being conspicuous in the east coast districts particularly noted for this class of fish (from the Moray Firth south to the Tweed) during the second decade of the century.

The increase of these age-classes, had been just as marked a characteristic of the forty years 1860-1900 as was their decline during the following twenty-plus years. A gradual latening of the salmon run as a whole reached its climax during the 1890s, slowly waning thereafter, until by the 1920s the late run was reduced to a shadow of its former self. From the second decade of this century, and particularly from 1921, the whole salmon run (2SW and older) became earlier. The pattern of this gradual decline of late-summer migrating stock is demonstrated by the statistics of most of the fisheries given previously.

In the Spey, as in many other rivers, this run, although steadily declining, remained considerable until 1922, from which season the August nets' catches became habitually the smallest numerically of any month. Table 86 compares the August salmon (2 + SW and older) catch in the nets of the Raik fishery over the five years 1901-1905 with the catch over the five years 1923-1927.

Table 86

Spey Raik Fishery: August Salmon (2 + SW and Older)

(Source: Gordon Richmond Fishings: Records.)

1901	-	1,263	1923	-	163
1902	-	664	1924	-	285
1903	-	771	1925	-	226
1904	-	373	1926	-	123
1905	-	685	1927	-	127
Average	=	751	Average	=	185

During the opening decade of the century the August catches of salmon (excluding grilse) in the Rossie fishery of the South Esk were the biggest of the season in both numbers and weights. In the quinquennial period 1900-04 August produced 29% by number of the salmon catch. The breakdown of the seasonal salmon catch by month at this fishery in 1900 was:

Table 87

Salmon (2SW and Older) Catch by Month in the Rossie Fishery of the South Esk 1900

(Source: Joseph Johnston & Sons Ltd., Records.)

Month	No.	%
Feb	30	2
March	116	6
April	148	8
May	470	25
June	245	13
July	239	13
Aug	607	33
	1,855	100

An important feature of this period is that the August catches in the nets were part of a big run that continued into the autumn months, necessarily unrecorded by the nets of most rivers, because netting ceased at the end of August, but evidenced by the autumn rod catches of the period. The following table described the beginning of the "autumn" run via the daily catches of salmon (excluding grilse) in the Rossie nets during August in the season of 1901:

Table 88

South Esk Rossie Fishery: August Salmon 1901 (2 + SW and Older)

(Source: Joseph Johnston & Sons Ltd., Records.)

Date	No. of Salmon	Date	No. of Fish
1st August	8	17th August	33
2nd "	9	19th "	82
3rd "	9	20th "	39
5th "	8	21st "	30
6th "	17	22nd "	13
7th "	5	23rd "	15
8th "	12	24th "	12
9th "	10	26th "	71
10th "	12	27th "	47
12th "	31	28th "	40
13th "	22	29th "	27
14th "	15	30th "	28
15th "	9	31st "	32
16th "	40	Total	676

Consequently the netting ended with the run apparently in full season. The South Esk late run of salmon started to decline rapidly during the second decade and by the 1920s was much reduced. By way of comparison with 1900-1904 the August nets catch of salmon over the five-year period 1923-27 averaged 227 (11%) out of an average total salmon catch of 2,046.

The records of the Elie fishery in the Firth of Forth, which was largely a summer fishery, indicate exactly the same pattern of events for August during the period. For the first quinquennial period 1900-04 the August salmon yield amounted to 35% of the seasonal catch. In subsequent successive quinquennial periods the August catches decreased to 30%, 22%, then 19%, finally bottoming out at 10% in the three year period of 1920-22, and remaining at a not markedly dissimilar proportion over the remaining twenty years (Table 71). The Kincraig fishing (Table 72) shows an even more marked decline from 38% in 1900-04 to 9% in 1935-40.

The proportionate decline of the August and September catches in the Tweed nets over the five year period 1910-15, is evident in the percentage figures of Table 76. An element of grilse, declining at the same period, would be incorporated into the figures, which nevertheless remain substantially valid.

This decrease of "autumn" stock was, of course, most evident to the salmon angling fraternity, and the books and sporting journals of the period contained comment levelling recrimination at various scapegoats held to be responsible for the shortage of fresh-run autumn salmon. The season of 1923, perhaps more than any other, seems to have been identified as the seminal year marking the

beginning of the end in this respect. In one of Jock Scott's books we read of the famous salmon angler Percy Laming:

> "Mr. Laming has fished the Spey for forty years, and he remarks on the changed habits of the salmon in this river, for the autumn fishing has practically ceased. Prior to 1923 sport in the autumn was more or less constant; but from that year the decline began, and now it is rare to see a reasonably fresh fish on the Spey at that time of the year. The same remark, of course, applies to the Dee, where the autumn fishing has likewise deteriorated." (Scott, 1936, 141.)

An article (by W. Mc.) in the Scotsman Newspaper of December 12, 1923, headed "The Tweed in 1923 - Spring and Autumn Contrasts" commented:

> "Whatever the cause may be, the facts are that Tweed is a spring river, and that though floods are frequent, fish are few in autumn... None can doubt the fact of the continuous decline of the Tweed in autumn.... the story of the back-end is one of failure written in large letters... For six consecutive back-ends no rod's catch has touched double figures in a day... Something must be done if Tweed salmon angling in autumn is to be more than a memory."

Although not a statistically verifiable behavioural characteristic, it is of interest to note that many anglers observed that as the "autumn" run declined its remnant appeared to become divorced altogether from the main salmon run, as this became earlier, and habitually did not arrive in the estuaries until the late autumn. This habit was noted not only in Scotland but throughout Britain.

The stock of late-summer migrating 2 + SW and older fish remained at a residual level throughout the rest of the period until 1950. Until 1920 such comment as the Reports of the Fishery Board for Scotland had to make about the pattern of return-migration dwelled on the decline of the grilse. However, the Annual Report for 1921 included the statement: "So far as river reports go, spring fish have been numerous, and angling in summer and autumn met with but little success.... Both in Scotland and England anglers have remarked for some years that spring fish appear to be increasing and autumn fish diminishing in numbers." (Appendix III, 91.) The Report for 1926 stated: "In fresh waters far more fish are now caught in spring than in autumn...." (Appendix V, 86), and the Report for 1937: "In August conditions for net fishing were again good but, although there was some slight improvement here and there in the run of large autumn fish, the quantity was very small compared with the results obtained thirty years ago." (p.66.)

Autumn salmon angling did not die out altogether. A few famous rivers, including Tweed, lower Tay, North Esk, South Esk, and lower Ness proper, some of the Solway and Ayrshire rivers, continued to offer sport. The Tweed does not close for the rod until 30th November, and the "back-end" fishing remained intermittantly reasonable throughout the period, November being the best month, although the autumn run was nothing like what it had been at the beginning of the century. In the North Esk and South Esk the late run of salmon tended to wane throughout the period and after 1945 became vestigial (North Esk: Tables 69, 70.) By 1950 only the Border rivers - Tweed and some of the Solway and Ayrshire streams - possessed any remaining reputation as true autumn rivers.

6. The Increase of Early-Running Salmon

By available historical standards the Scottish salmon fishery during the twenty-four years 1897-1920 appeared to be at a rather low ebb. Following the decline of the great grilse migration of many years during the 1880s and 1890s no other run of fish arrived to compensate the commercial industry for the loss of grilse - not, at least, during the netting season (there were heavy runs of gravid salmon after netting had finished throughout the 1890s and early 1900s.)

The harbinger of a vastly different pattern of return-migration first appeared clearly during the second decade of the century in the shape of a gradual increase of early-running salmon matched by a more-or-less corresponding decline of the late-running stock. Not all rivers reflected this change proportionately in their catches, but the general change is obvious enough in outline from the earlier statistics.

This gradual growth of the early, so-called "spring", run may be said to have reached fruition in the seminal season of 1921. The Fishery Board Report for that year commenced: "The season of 1921 showed a remarkable recovery from the depressed condition which has been reported for some years", and continued subsequently: "All parts of the coast appear to have participated in the increase to a greater or lesser extent, with the exception of places dependent upon the take of grilse...." In other words the great improvement was salmon-based (2SW and older fish). Moreover: "The outstanding features of the successful season have been the very steady supply of salmon during the spring

months, the rather heavier weights of the spring fish, and the absence of grilse. The abundant spring fish were also found to be of very fine quality." Hence, the resuscitation of the salmon migration was essentially based on an improved early run. (Report of the Fishery Board for Scotland, 1921, 51-52.)

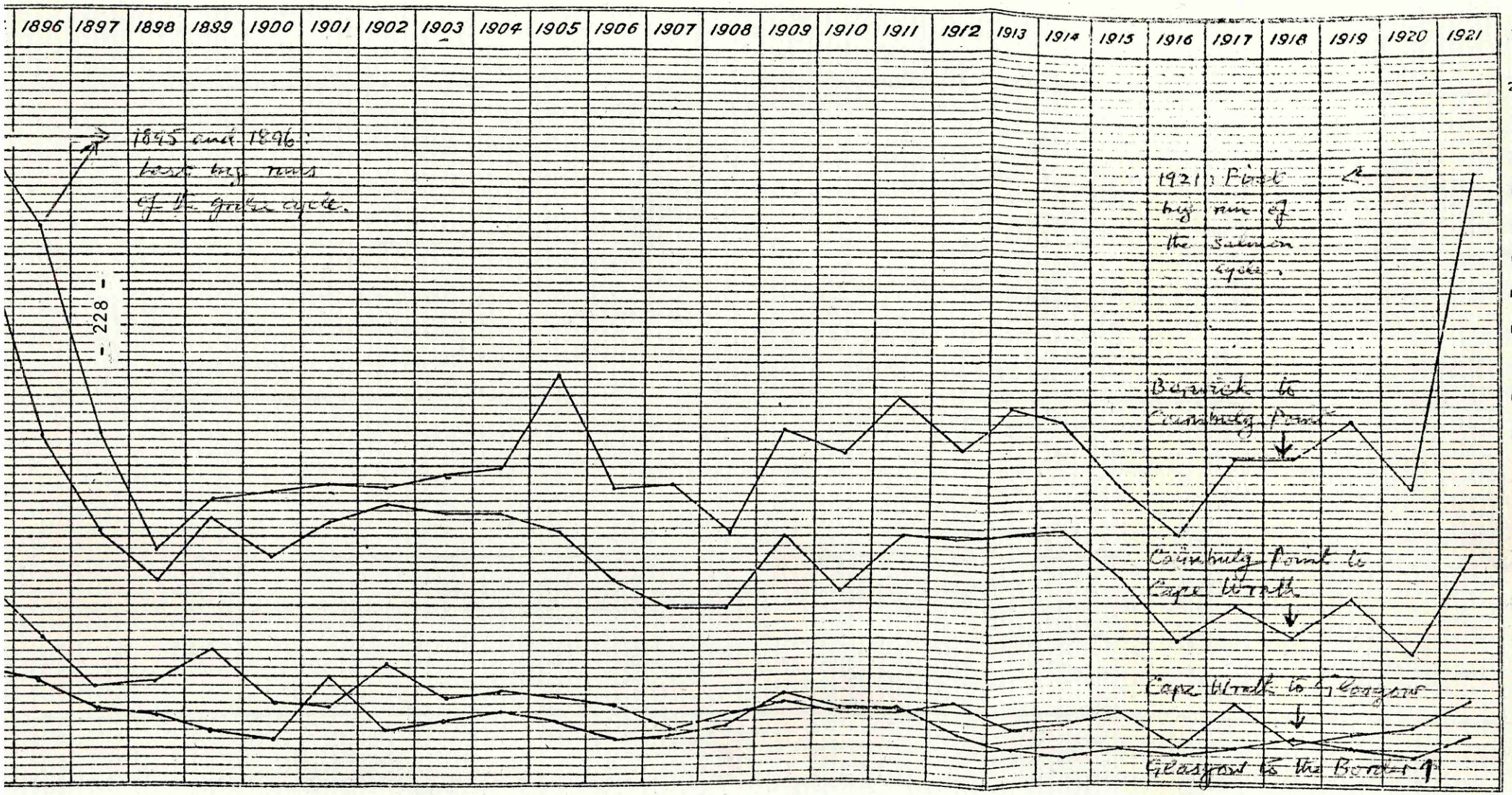
The same Report incorporated a graph (Figure 7) that provides the estimated weight of salmon and grilse carried by the Scottish railway and shipping companies throughout the period 1894 to 1921. This highlights the peak catches of 1895-96, the trough of 1897-1920 and the peak catch of 1921, the difference between the two peaks being that the earlier one was comprised substantially of grilse and the later one substantially of early-running salmon. (The tonnages of the graph were estimated gross of the weight of boxes, ice and double-handled fish.) (Ibid., 52.)

Furthermore, evidence was offered to the effect that the great increase of salmon occurred substantially within the geographical bounds of one extended locality on the east coast, incorporating a number of traditional districts: "So far as the nets are concerned, the great spring run of 1921 was most marked in the section of the coast between Berwick and Inverness" (Ibid., Appendix 3, 91), that is largely within the region shown on Figure 7 as being between Berwick and Cairnbulg Point, which is at the entrance to the Moray Firth.

The 1921 Report did not make further comment, but a number of conclusions may be drawn about the nature of the pattern of return migration that became dominant from 1921 in the light of available knowledge about the return migration pattern of the 1920s and, indeed,

CURVES SHOWING APPROXIMATELY THE GROSS TONS OF SALMON CARRIED BY SCOTTISH RAILWAYS & STEAMSHIPS SINCE 1894

FIGURE 7



Source: Annual Report of the Fishery Board for Scotland, 1921.

of the three decades 1921-1950.

The first conclusion is that the great increase of early-running fish occurred primarily in the east-coast region formerly noted for late-running salmon i.e. from Berwick"North"and round to Inverness the gradual decline of the late run of salmon was replaced by an increasing early salmon run, and this changing seasonal cycle achieved its consummation in the season of 1921, from which date the early-running salmon predominated and the late run became a residual stock.

An extract from the Fishery Board Report for the 1927 season (p.87) read:

> "I have the honour to report that in 1927 the salmon fisheries of Scotland were even more successful than in 1926. The catch sent to market amounted to 2,910 tons (gross), a figure which has not been reached since 1896. At the same time this remarkable rise was not experienced all round the coast, but was confined to the eastern seaboard between Berwick and Cairnbulg. The rise, as compared with 1926, in this section of the coast was 343 tons. In all the other sections there was a decrease; on the west side between Cape Wrath and the Clyde a decrease of 58 tons."

Table 89 provides the comparative annual tonnages catches for the section of coast between Berwick and Cairnbulg, near Frazerburgh, over the period 1894 to 1927, and demonstrates the greatly increased catches for the seven years 1921-1927.

Table 89

Berwick to Cairnbulg Point: Comparison of Annual Tonnages of Salmon and Grilse Caught in the Commercial Fishery 1894-1927

(Source: Report of Fishery Board for Scotland, 1927, 87.)

	Tons		Tons		Tons
1894	963	1906	834	1917	922
1895	1,834	1907	847	1918	919
1896	1,583	1908	715	1919	1,027
1897	987	1909	1,018	1920	828
1898	666	1910	934	1921	1,736
1899	819	1911	1,112	1922	1,414
1900	826	1912	950	1923	1,250
1901	843	1913	1,061	1924	1,785
1902	835	1914	1,030	1925	1,505
1903	867	1915	847	1926	1,570
1904	881	1916	701	1927	1,913
1905	1,158				

The second conclusion is that, based on the statistics that have been isolated and on contemporary comment, the rivers of north-eastern and northern Scotland, extending from the Beauly near Inverness round to the Naver on the north coast, which together comprise what may be described as the second major salmon district of Scotland, did not in 1921 or thereafter share to the same extent the increased migration of early salmon. It is suggested that this may have been because of the essentially different nature of these rivers, or this district, as compared to most of the rivers of the

premier district extending from Inverness along the southern shore of the Moray Firth and right down the east coast as far as Tweed.

These north-eastern rivers had always within the recorded past been noted for one more-or-less continuous spring and early-summer salmon run, for a comparative lack of late-running salmon, but with a big stock of grilse. (This pattern they share with the medium-sized Irish rivers of many districts.) The runs of these rivers of the north-eastern district did and do respond to the causal factors guiding variations in the age-classes comprising the total return-migration at the same time as the southern rivers, but in a different way, in the form of a limited straight exchange largely between 1SW and 2SW stock but not incorporating to any apparent marked degree the additional periodic dimension of great seasonal variations in the return-migration of the 2SW and older fish that characterise the more southerly east-coast rivers of any volume. Furthermore, they did and do enjoy, if in varying degrees, the character and reputation of grilse rivers, much more so than most of the rivers south of Inverness where the grilse stock may and does vary very substantially inter-cyclically. It is, or appears to be, a characteristic of this type of river to produce in periodic cycles when grilse are dominant throughout Scotland great runs and catches of grilse. But at periods when the salmon migration is particularly strong in the southern rivers these northern rivers, or some of them, do not appear to receive from the salmon adequate compensation by number or weight for the partial loss of their great grilse run. Such seems to have been the position after 1921 in these rivers: Although continuing to enjoy in an enhanced degree their traditional reputation for quality spring rod

fishing, as overall fisheries and districts they never recovered from the great decline of grilse after the turn of the century (Table 90).

Another factor that influences the interpretation of comparative events in different districts is that the big increase of the commercial catch of the southern district from 1921 reflected in part the fact that the development of the early salmon migration resulted in more fish being available for the nets to catch than when so many gravid fish were running during the autumn and early winter; in part the fact that the combined salmon and grilse run of the north-eastern district probably at all times remains substantially within the commercial salmon season and therefore available to catch; and in part that some of the southern rivers (many of which are much bigger and more prolific than the north-eastern rivers) had within their enhanced salmon run from 1921 greater proportionate quantities of 3SW and older fish than the north-eastern rivers, thus helping to boost the overall comparison by weight between the two districts.

Not only the north-eastern district suffered significantly from the decline of grilse after the turn of the century. The small-river districts of the north-west and west coasts, and also the Solway rivers, all strongly reliant on grilse, received inadequate compensation for their loss of grilse by the increase of salmon. The decline in all these districts was absolute, as the following catches testify:

Table 90

Comparison of the Average Tonnages of Salmon and Grilse Caught in the Scottish Commercial Fishery 1894-1934

(Source: Report of the Fishery Board for Scotland, 1934, 66.)

	Average 1894-98 Tons	Average 1899-03 Tons	Average 1904-08 Tons	Average 1909-13 Tons	Average 1914-18 Tons	Average 1919-23 Tons	Average 1924-28 Tons	Average 1929-33 Tons	Year 1933 Tons	Year 1934 Tons
Berwick to Cairnbulg Point	1,207	839	887	1,015	884	1,252	1,620	1,558	1,496	1,539
Cairnbulg Point to Cape Wrath	901	738	609	665	519	509	568	729	694	656
Cape Wrath to Glasgow	403	275	209	205	157	183	214	155	139	208
Glasgow to the Border	260	183	161	172	92	116	179	146	159	111
Total Tonnages	2,771	2,035	1,866	2,057	1,652	2,060	2,581	2,588	2,488	2,514

Although, as was stated earlier, the commercial nets benefitted by the increased early run from 1921, as compared to the late-running salmon period that preceded it, the salmon rod fishing benefitted even more. From 1921 particularly the winter and early-spring migration of most east-coast districts between the Moray Firth and Berwick increased dramatically. Quantities of fish ran many rivers before commercial netting had commenced, and even after the start of the commercial season many more fish than hitherto gained access to the rivers during the high waters of the early spring.

The greatly increased rod catches from 1921 reflected not only the large quantities of salmon entering the rivers but also the fact that, for the angler, early-running fish are the best stock of all, since "spring" fish are "taking" fish whereas late-run gravid fish, although they may be abundant, are not free-rising fish for long after they have entered the rivers. From the 1921 season particularly the anglers began to catch a highly significant proportion of the total salmon stock, in many rivers vying to compete with the results from the nets, and frequently exceeding the netted catch until May.

Arthur Wood of Cairnton (Dee) fame estimated that the average annual catch of salmon, nearly all spring-migrating fish, in the Aberdeenshire Dee by the rods during the 1920s and 1930s was about 11,000.* For the Tweed the angling catch was only c.1,500 - 3,500 fish in most seasons early in the century and the large majority of these were caught in October and November. The rod catch gradually increased from the second decade to reported numbers in excess of 10,000 fish some seasons, particularly during the 1930s, the large majority of them spring fish. Daily catches of ten spring fish by

* The rods-nets relationship in the Dee is an eminently rational one, having regard to the nature of the return migration in this river, and during many seasons of this century the rods salmon (excluding grilse) catch has comfortably exceeded the netting catch.

a single angler became almost commonplace, and individual catches of from 20 to 30 in a day were recorded. If not on the same scale as in Tweed and Dee all the other sizeable rivers between the Moray Firth and Berwick recorded considerably or greatly increased catches by the rods from the early 1920s compared to what they had previously been.

Such catches by sportsmen lay some emphasis on the need to recognise the fact that most of the sets of net catch statistics given earlier are reliable indications only of changes in the return-migration, except for grilse, and do not by themselves convey the full scale of the development of the early-running salmon cycle.

This big early salmon migration continued throughout the 1920s and the 1930s and into the early 1940s. During the middle years of the 1940s the run of both salmon and grilse declined to a low ebb, but by the last three years of the period 1948-50 the salmon run was rapidly recovering its former strength, and still remained overwhelmingly a winter, spring and early summer migration. The grilse run, however, continued at a low level through to 1950.

More analysis of the salmon migration during 1900-1950 is incorporated into the following chapter on fish weights, in connexion with which it tends to have greater significance.

7. Salmon and Grilse Weights

Introduction

The weights analysis for the period consists primarily of general comment from contemporary sources on the nature of the salmon and grilse runs in the 1920s and 1930s. These reflect the great changes in the return-migration that had occurred since the early part of the period. More detailed analysis on the nature of the runs in a number of major and prolific river systems is also given.

Detailed information either does not exist or is extremely difficult to obtain about individual fish weights in many rivers, because total salmon and total grilse weights were often aggregated in the records. It is rather remarkable that, whereas numerical unit catches were recorded scrupulously at many commercial fisheries, the fish weights should be so frequently aggregated, at least into total salmon and total grilse.

Resulting from the changes occurring during the opening two decades of the century, the salmon weights during this fifty year period were primarily functions of a decline in the late-summer running stock, mainly of heavy 2 + SW fish, and a corresponding increase of early-running 2SW fish combined with an increase of 3SW early-running stock, i.e. as the quantities of 2SW fish increased the residual stock of 3SW fish increased. Because of aggregation of weights it is not easy to isolate the proportions of 3SW and 2SW fish in many sets of statistics.

The grilse weights from the opening of the period reflect the dual facts that as the grilse runs declined numerically they progressively became earlier in many systems, resulting in a

decline of average weights. The great grilse period of the 1880s and 1890s was already sharply in decline by the opening years of the new century and the full effects of the changes in grilse weights are best seen by comparing the position during 1915-19 with the position during the 1880s and 1890s up to 1896.

The general position in regard to salmon weights is more complex than in regard to grilse, reflecting the fact that in the main east-coast districts of Scotland, in the big-river districts particularly, the salmon run may endure throughout the season and periodic variations in the timing of the main return-migration may be of seminal significance to both the commercial and the sporting interests, whereas the main grilse run always takes place during the summer and early autumn months, varying moderately by season if substantially by quantity.

Statistical analysis by weights of the catches in a number of major rivers follows subsequently, but this analysis is not in most examples complete for the period, and in any case the total migration is only the sum of many rivers of somewhat varying characteristics, according to their inherent natures. A general description of the salmon migration as relating to fish weights from contemporary sources is therefore provided.

Although the main salmon run by the 1930s had become so much earlier than during the opening decade of the century, specific timing and the mix of fish by age and consequently by weight varied considerably from season to season. A principal characteristic of the run by the 1920s and the 1930s was an enhanced migration, more in evidence some seasons than in others, of 3SW big spring fish.

This run of big fish was more characteristic of some river systems than others.

The Fishery Board for Scotland's Report for the 1934 season demonstrated how conspicuous this migration of heavy early-running fish had become by some seasons of the 1920s and particularly the 1930s:

> "A feature of the early part of the season was undoubtedly the very good run of early fish in December, January and the first week of February, followed by a break throughout the remainder of February and March when the number of fish coming to the coast and into the rivers was comparatively small.... In April and May the run of small spring salmon improved considerably and was probably up to the average for those months. The condition of affairs in the spring season was well illustrated by the fact that in the market for a long period small fish were fetching a higher price than large salmon, whereas the reverse is normally the case."

In other words, there was in 1934 a strong run of big (mostly 3SW but with a smattering of 4SW) winter fish, together with an unusually well-marked lapse of time between the principal run of the big spring fish and the subsequent main run of the small spring fish. The characteristic of a main run of small spring fish in April and May (often March, April and May) was more essentially a property of the smaller rivers of the east coast. Some of the bigger ones, e.g. Tweed and Aberdeenshire Dee, had at this period a substantial run of small spring fish throughout the winter and early spring.

A buoyant migration of 3SW and 2SW fish throughout periods of

the winter and spring months was therefore a characteristic feature of the early-running salmon cycle. As regards the extension of the salmon (as opposed to the grilse) run into the summer months at the period, this was variable according to season and district. The Fishery Board for Scotland Report for the 1937 season, referring to the late spring and summer run, observed:

> "A feature of this period was the exceptionally good run of salmon in May and June. In July some small spates allowed grilse and sea-trout to ascend to fresh water. Grilse on the east coast were not quite so plentiful in the last two years and less so on the north coast. On the west coast the run of summer salmon and grilse was the worst for possibly the last fifty years. No reason can be assigned for this scarcity.... In August conditions for net fishing were again good but, although there was some slight improvement here and there in the run of large autumn fish, the quantity was very small compared with the results obtained thirty years ago." (p.66). Consequently, the main general salmon migration ended with June or July, according to district, in 1937.

The winter and early spring salmon migration was the principal migration in some seasons, not just in some rivers, at the period. The Fishery Board of Scotland's Report for the season of 1938 described the spring fishing as "moderately good over the whole of the east coast" and continued:

> "The exceptionally good run of salmon in May and June mentioned in the Report for 1937 was not repeated in 1938, and, once summer salmon and grilse began to run, the output of the fisheries

changed materially. As in 1937 the crop of grilse on the west-coast was very poor, and this scarcity was repeated on the north and east coasts, where the total grilse catch was probably not more than a third of that of 1937. The autumn run of salmon was also poor in all districts, and shows no sign of any return to its former importance." (p.67).

All these seasonal factors are highly material in considering the various permutations of average fish weights offered hereinafter. As previously mentioned in regard to grilse, the full effects of the changes in the salmon weights by season and age are best obtainable by comparing the position in the 1920s and 1930s with the position during the 1880s and 1890s.

The weights analysis includes information on the four principal rivers and districts of Scotland: Spey, Aberdeenshire Dee, Tweed and Tay.

The Spey

The Raik fishery statistics provided in chapter two did not incorporate average fish weights. However, the Gordon Richmond Fishing records did include the average weights of salmon and grilse sent from the Spey to a number of London merchants. The supply to Messrs. Forbes, Stuart, the merchant that received the largest quantity of fish throughout the period has therefore been analysed as to three separate three-year periods at the beginning, the middle and the end of the period, for purposes of comparison of the variations by fish weight at the stated intervals:-

Table 91

Spey: Comparative Weights of Salmon and Grilse 1901-50

(Source: Gordon Richmond Fishings, Records.)

SALMON	1901		1902		1903	
Weight Lbs	No.	Av.Wt	No.	Av.Wt	No.	Av.Wt
February	993	8.6	1,116	7.9	762	9.0
March	532	9.1	233	9.0	424	9.4
April	678	10.0	263	9.3	797	9.5
May	688	11.0	558	10.7	437	10.8
June	705	12.7	379	12.0	786	12.0
July	682	14.6	560	14.3	581	15.0
August	985	17.3	658	17.9	810	18.2
	5,263	12.1	3,767	11.6	4,597	12.2
GRILSE						
Weight Lbs						
May	52	2.6	18	2.5	3	2.0
June	766	3.6	552	4.2	558	3.6
July	2,508	4.4	3,101	5.1	2,284	4.3
August	770	5.1	490	6.3	705	5.3
	4,096	4.4	4,161	5.1	3,550	4.4

SALMON	1926		1927		1928	
Weight Lbs	No.	Av.Wt	No.	Av.Wt	No.	Av.Wt
February	436	10.0	689	11.5	489	10.6
March	791	9.6	1,238	11.4	855	11.0
April	964	9.5	1,143	11.6	866	10.6
May	1,952	10.1	929	11.8	1,864	10.6
June	1,473	11.3	1,213	12.3	1,873	12.0
July	1,841	13.0	901	14.0	1,359	13.9
August	381	14.4	519	16.2	515	15.9
	8,838	11.1	6,632	12.4	7,821	11.9
GRILSE						
Weight Lbs						
May	19	2.4	4	2.5	17	2.4
June	1,321	4.5	313	3.5	507	3.6
July	5,075	4.9	2,329	4.4	2,591	4.4
August	470	5.0	491	4.5	592	4.4
	6,885	4.8	3,137	4.3	3,707	4.3

SALMON	1948		1949		1950	
Weight Lbs	No.	Av.Wt	No.	Av.Wt	No.	Av.Wt
February	174	10.8	214	10.4	474	10.5
March	594	11.5	719	10.2	604	10.8
April	893	12.1	726	10.5	494	11.2
May	1,668	12.9	1,646	11.0	1,530	11.7
June	847	13.8	2,496	12.2	1,260	12.5
July	219	15.4	1,546	13.6	658	14.0
August	112	16.0	268	13.7	200	15.0
	4,511	12.9	7,615	11.9	5,220	12.1
GRILSE						
Weight Lbs						
May	4	3.8	4	3.5	4	3.3
June	246	4.9	1,580	4.6	410	4.3
July	695	5.4	4,723	5.3	1,711	5.0
August	146	5.9	341	5.5	593	5.3
	1,091	5.3	6,648	5.1	2,718	5.0

The following information has also been abstracted from scientific papers of the 1920s covering the five seasons 1921-25 inclusive. Sources for the full five years are provided at the end of the Spey analysis:-

Table 92

River Spey: Analysis of Nets' Catch in 1921

	1. Total Catch by Sweep Nets in Lower River %		2. Fish Sampled from Sweep Nets %		3. Total Catch by Fixed Engines around River Mouth %	
	Salmon	Grilse	Salmon	Grilse	Salmon	Grilse
February	14.4		9.4		5.9	
March	10.3		13.4		7.3	
April	11.7		19.8		10.9	
May	17.1		27.6	0.2	16.7	
June	23.0	37.5	21.3	63.4	39.2	53.3
July	20.7	60.3	3.5	36.4	15.6	45.2
August	2.8	2.2	5.0	-	4.4	1.5
	100.0	100.0	100.0	100.0	100.0	100.0

The total number of fish sampled in schedule 2 above was 2,323, divided as to 1,864 salmon and 459 grilse. These numbers of fish by age and their related average weights in lb. by month were as follows:-

Table 93

River Spey: Average Weights of Salmon and Grilse from Samples 1921 in lb.

Sea Age	1+	Av.Wt	2	Av.Wt	2+	Av.Wt	3	Av.Wt	3+	Av.Wt	Total
February	-	-	127	8.3	-	-	38	17.4	-	-	165
March	-	-	196	8.9	-	-	43	18.9	-	-	239
April	-	-	264	10.3	58	11.4	35	23.0	1	29.0	358
May	1	4.0	172	9.7	279	10.9	40	20.2	3	25.5	495
June	291	4.1	20	9.8	323	12.3	20	19.1	7	23.9	661
July	167	4.6	-	-	49	14.9	-	-	3	29.3	219
August	-	-	5	9.4	80	20.1	1	25.0	5	32.0	91
	459	4.3	784	9.5	789	12.7	177	19.7	19	27.4	2,228

In addition there were 2 4SW fish both weighing 34.0 lbs and 1 4 + SW fish weighing 33.0 lbs, plus 86 fish with one spawning mark and 6 fish with two spawning marks, yielding 2,323 fish in all for 1921.

Table 94

Analysis of Nets' Catches in 1922

1922	1. Sweep Nets Catch		2. Fish Sampled from Sweep Nets		3. Sea Fixed Nets Catch	
	Salmon	Grilse	Salmon	Grilse	Salmon	Grilse
February	14.8		4.3		4.3	
March	18.2		28.7		7.1	
April	17.5		23.6		8.4	
May	7.4		16.3	1.6	14.1	
June	16.0	21.0	19.7	50.9	25.9	29.2
July	11.5	60.5	3.9	43.0	16.0	54.2
August	14.6	18.5	3.5	4.5	24.2	16.6
	100.0	100.0	100.0	100.0	100.0	100.0

The number of fish sampled from the sweep nets amounted to 2,604, plus 51 clean fish netted, marked and released in November 1921, yielding a total of 2,655: 2,022 salmon and 633 grilse. The average ages and weights were:

Table 95

River Spey: Average Weights of Salmon and Grilse from Samples 1922 in lb.

	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
November	-	-	5	8.8	-	-	42	16.9	-	-	-	-	47
February	-	-	55	8.3	-	-	16	18.3	-	-	-	-	71
March	-	-	394	8.3	-	-	130	19.4	-	-	2	44.5	526
April	-	-	301	9.2	45	11.0	93	21.3	-	-	3	37.0	442
May	10	3.2	79	8.9	199	10.9	27	20.0	-	-	1	30.0	316
June	322	4.0	25	9.2	335	13.0	15	20.7	4	25.1	-	-	701
July	272	4.7	5	6.6	62	15.7	4	17.3	1	31.0	-	-	344
August	29	5.4	-	-	64	19.1	1	14.0	3	32.0	-	-	97
	633	4.3	864	8.7	705	13.0	328	19.6	8	28.4	6	38.3	2,544

There were in addition 104 fish with one spawning mark and 7 with two spawning marks in 1922.

1923

No breakdown in percentage form of the lower river and coastal nets was provided for this year. No samples were collected for February and March. The total sample amounted to 1,763 fish, of which 1,260 were salmon and 503 grilse. The corresponding average ages and weights were:-

Table 96

River Spey: Average Weights of Salmon and Grilse from Samples 1923 in lb.

	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
April	-	-	267	9.3	57	10.7	28	19.1	-	-	1	20.5	353
May	4	4.5	276	9.7	215	12.0	28	20.3	1	35.0	1	35.5	525
June	143	4.5	21	8.6	185	13.0	5	10.9	1	28.0	-	-	355
July	343	4.8	5	9.0	77	15.6	1	25.0	1	25.0	-	-	427
August	13	4.5	5	6.5	12	15.0	1	23.0	-	-	-	-	31
	503	4.7	574	9.5	546	12.8	63	19.9	3	29.3	2	28.0	1,691

A further 70 fish had one spawning mark and 2 a second spawning mark in 1923.

1924

The total river and coastal nets catches were combined for this year and provided in percentage form. The samples were taken from the river nets, but none were taken during August.

Table 97

River Spey: Analysis of Nets' Catch in 1924

	Total Catch		Sample	
	Salmon	Grilse	Salmon	Grilse
February	7.1	-	18.8	-
March	14.3	-	18.8	-
April	19.8	-	19.8	-
May	18.2	1.3	19.8	3.3
June	16.4	15.5	14.8	26.9
July	16.4	71.0	8.0	69.9
August	7.8	12.2	-	-
	100.0	100.0	100.0	100.0

The number of fish sampled was 2,477, of which 1,967 were salmon and 510 grilse. Average ages and weights were:-

Table 98

River Spey: Average Weights of Salmon and Grilse from Samples 1924 in lb.

	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
February	-	-	250	8.7	-	-	84	20.2	-	-	1	34.0	335
March	-	-	274	9.4	-	-	71	21.0	-	-	1	34.5	346
April	-	-	310	9.4	18	11.0	47	21.3	-	-	1	25.0	375
May	17	3.2	175	10.0	174	11.5	30	19.9	1	26.0	-	-	397
June	137	3.9	51	9.9	213	12.2	14	19.1	2	34.0	-	-	417
July	356	4.6	4	5.9	134	13.8	2	23.5	5	28.0	-	-	501
	510	4.3	1,064	9.4	539	12.4	248	20.6	8	29.3	3	31.2	2,371

There was also 96 fish with one spawning mark, 8 with two, and 1 fish with three spawning marks in 1924.

1925

No percentage details of the total nets catches were provided. No samples were taken during the month of July. The number of samples was 1,511, and their average ages and weights were:

Table 99

River Spey: Average Weights of Salmon and Grilse from Samples 1925 in lb.

	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	Total
February	-	-	161	10.1	-	-	23	19.2	-	-	184
March	-	-	243	9.9	2	9.5	49	20.2	-	-	294
April	-	-	134	10.4	18	13.2	28	21.4	-	-	180
May	4	3.0	134	10.6	100	12.5	23	22.0	-	-	261
June	78	3.8	42	10.7	121	13.0	9	21.2	-	-	250
July	-	-	-	-	-	-	-	-	-	-	-
August	100	5.7	2	-	106	17.5	5	22.8	6	30.0	219
	182	-	716	10.2	347	-	137	20.7	6	-	1,388

In addition there were in 1925 2 4SW fish weighing 36 and 38 lbs, and 2 4 + SW fish weighing 52 and 31 lbs. There were also 119 fish with one spawning mark. (Sources: Fisheries, Scotland, Salmon Fish, 1921 No. 2, 1924 No. 1, 1926 No. 5, 1928 No. 1, 1928 No. 3.)

Summary of Principal Variations in the Spey

The Raik fishery statistics show that during the 1920s and 1940s there was a marked increase in the average weights of the spring fish as compared with the average weights of the spring fish during the

opening decade of the century. This enhanced average weight continued in the salmon run until the early summer months, but during the later summer the average weight became noticeably lighter than during the opening decade.

The statistics are inadequate for certainty, but the low average weight of the spring fish during 1901-1903 may have resulted from there being few 3SW big spring fish at that time as compared to the proportion of this age of fish during the period 1920-1950. It is possible that the salmon run during the later summer months of 1901-03 may have contained a greater proportion of 3 + SW fish than the same period during 1920-1950, but a more likely explanation is that the salmon run was fundamentally different in structure in the opening decade as compared to 1920-50, in that the salmon migration of the first decade consisted markedly of 2SW fish that grew rapidly at sea during the summer months and migrated in large numbers during the later season, whereas during 1920-1950 the salmon migration as a whole was much earlier and contained a considerable proportion of 3SW fish, the late-summer run being reduced both in numbers and in average weight.

As regards the grilse, two factors are particularly noticeable: (a) As with the reduced numbers and average weights of the late salmon, the August-running grilse of the 1920s were reduced both by numbers and by incremental average weight over the July grilse, as compared with the opening decade. Perhaps both the salmon and the grilse runs were influenced by similar climatic-environmental factors? (b) By the later 1940s the average weight of the grilse was increasing significantly compared to both the 1920s and opening decade.

The 1921-25 detailed analysis shows a tendency for the 3SW fish to be proportionately a greater part of the total migration at the beginning of the season, in February, declining through March and April, but then increasing once again proportionately as the spring run declines during May and June. The November sampling during 1921 recorded in the 1922 analysis emphasises the early-running characteristics of the 3SW fish. There were few summer-running fish of the 3 + SW class during 1921-25.

The salmon run of the 1922 season marked a partial reversion to the pattern of the opening years of the period, as compared to 1921 and 1923-25.

The Aberdeenshire Dee

The quinquennial average weight of salmon caught in the sea (i.e. lower estuary) nets and in the lower river nets of the Aberdeen Harbour Board's netting stations, together with an associated theory about their significance, were offered earlier. The table of average salmon weights 1872-1950 is reproduced for easy reference (Table 100).

A Table (101) and then a derived graph (Figure 8) of the average weights of salmon caught in a prolific rod fishery (Cairnton) of the Aberdeenshire Dee 1920-1932 inclusive are given next. Figure 8 relates to spring fishing only, covering the period February to the first week of June. Although the 2 lb and 3 lb columns do include some very small spring fish they are excluded from consideration in the analysis because it seems obvious, from the fact that in some seasons the 2 lb fish exceed the 3 lb fish in numbers and the 3 lb fish the 4 lb fish, that a few small grilse began to appear in the catches in May and the beginning of June. The average weights are

given in 1 lb increments, and logically this should indicate that an 8 lb fish was the average of all fish caught c.7.5 to c.8.4 lb.

The third Table (102) comprises the annual average total grilse weights 1872-1950 in the catches of the Harbour Board. These are given by the individual year, not in quinquennial averages, because it is easier to observe the changes in the grilse weights by this means.

Fourthly, there is an analysis of detailed salmon and grilse average weights for the five years 1921-15 (Tables 103-114).

Finally, Jock Scott's volume "Game Fish Records" (1935, 95) provides a description of a catch of late-summer fish made in October 1918, in the Park House beat of the lower Dee, that may be taken as more or less typical (see Tweed later) of the heavy classes of fish caught by the rod in the autumn early this century, that rapidly died out between 1915-1930, according to river; in the Dee and many others particularly between 1915 and 1920. Scott states that Ernest Crosfield caught eleven successive fish weighing 17, 20, 22, 22, 22½, 23, 23, 24, 27, 27, 30 lb. Possibly all these fish were of the 2 + SW class but the three 27-30 lb, or some of them, might have been of the 3 + SW class.

Table 100

Analysis of the Salmon Caught in the Sea and River Nets of the Aberdeen Harbour Board in the Aberdeenshire Dee 1872-1950

(Source: Aberdeen Harbour Board, Records.)

Quinquennial Averages	Salmon - Sea Nets			Salmon - River Nets		
	Av. Annual No.	% of Total Catch	Av. Annual Weight(lb)	Av. Annual No.	% of Total Catch	Av. Annual Weight(lb)
1872-75 (4 yrs)	5,112	(89)	11.61	600	(11)	9.69
1876-80	3,865	(86)	12.42	651	(14)	9.80
1881-85	4,387	(77)	10.93	1,276	(23)	9.31
1886-90	5,142	(80)	10.79	1,273	(20)	8.90
1891-95	5,918	(81)	11.02	1,371	(19)	9.21
1896-1900	4,164	(78)	11.63	1,169	(22)	9.05
1901-05	3,745	(80)	10.83	943	(20)	8.89
1906-10	3,291	(68)	10.27	1,536	(32)	8.70
1011-15	3,026	(63)	10.61	1,742	(37)	9.01
1916-20	3,770	(65)	10.02	2,037	(35)	9.05
1921-25	3,845	(61)	10.72	2,426	(39)	10.18
1926-30	5,465	(58)	10.41	3,882	(42)	10.00
1931-35	4,862	(57)	10.70	3,721	(43)	10.69
1936-40	5,034	(60)	10.47	3,380	(40)	10.44
1942-45	3,667	(62)	10.86	2,212	(38)	10.37
1946-50	3,267	(59)	10.30	2,277	(41)	10.15

Table 101

CAIRNTON

YEARLY NUMBER OF SALMON AT DIFFERENT WEIGHTS

Year	Lbs. 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total
1920	. .	8	3	36	93	189	162	82	23	16	17	8	8	11	18	8	7	7	5	3	1	1	1	—	1	1	1	706
1921	. .	—	3	14	39	82	46	25	9	1	8	11	9	2	2	3	5	4	1	—	2	—	1	—	—	2	—	290
1922	. .	—	9	28	77	113	68	45	20	12	11	20	18	27	30	16	17	9	9	8	6	7	2	2	2	1	1	564
1923	. .	—	3	26	96	121	117	75	29	23	13	22	18	9	11	12	6	3	3	3	1	—	2	—	—	—	—	603
1924	. .	5	3	8	10	32	82	71	45	24	15	6	9	8	11	13	10	6	6	5	1	2	4	2	1	1	—	591
1925	. .	1	7	2	6	28	78	108	91	47	28	22	7	12	8	6	7	5	3	2	—	2	1	—	3	—	—	479
1926	. .	1	2	15	29	91	130	94	48	20	15	5	2	4	6	5	3	7	1	4	1	1	2	—	—	1	—	505
1927	. .	—	6	6	—	19	29	96	101	64	37	13	26	14	16	22	14	12	9	11	9	6	2	3	—	3	1	521
1928	. .	2	3	4	13	46	87	98	45	26	19	9	7	5	11	12	10	6	5	7	3	5	4	1	—	1	—	430
1929	. .	1	4	5	17	44	52	63	20	15	4	6	10	10	12	9	14	13	10	3	4	3	—	4	—	—	—	323
1930	. .	3	11	9	17	38	80	92	55	10	14	21	14	16	34	12	8	12	9	4	6	2	3	1	—	1	2	476
1931	. .	—	6	10	20	75	170	176	111	66	27	21	23	24	25	19	14	10	>8	6	3	1	2	1	1	—	—	824
1932	. .	—	1	3	3	23	44	59	34	43	24	13	11	11	13	11	11	4	6	10	8	5	5	—	4	—	2	1	371

Big Fish

Year	Lbs. 29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			Total
1920	. .																								
1921	. .	1																							1
1922	. .	1		1					1																3
1928	. .	1		1										1											2
1930	. .		1																						1
1931	. .	2				1																			1
1932	. .	1														1									2

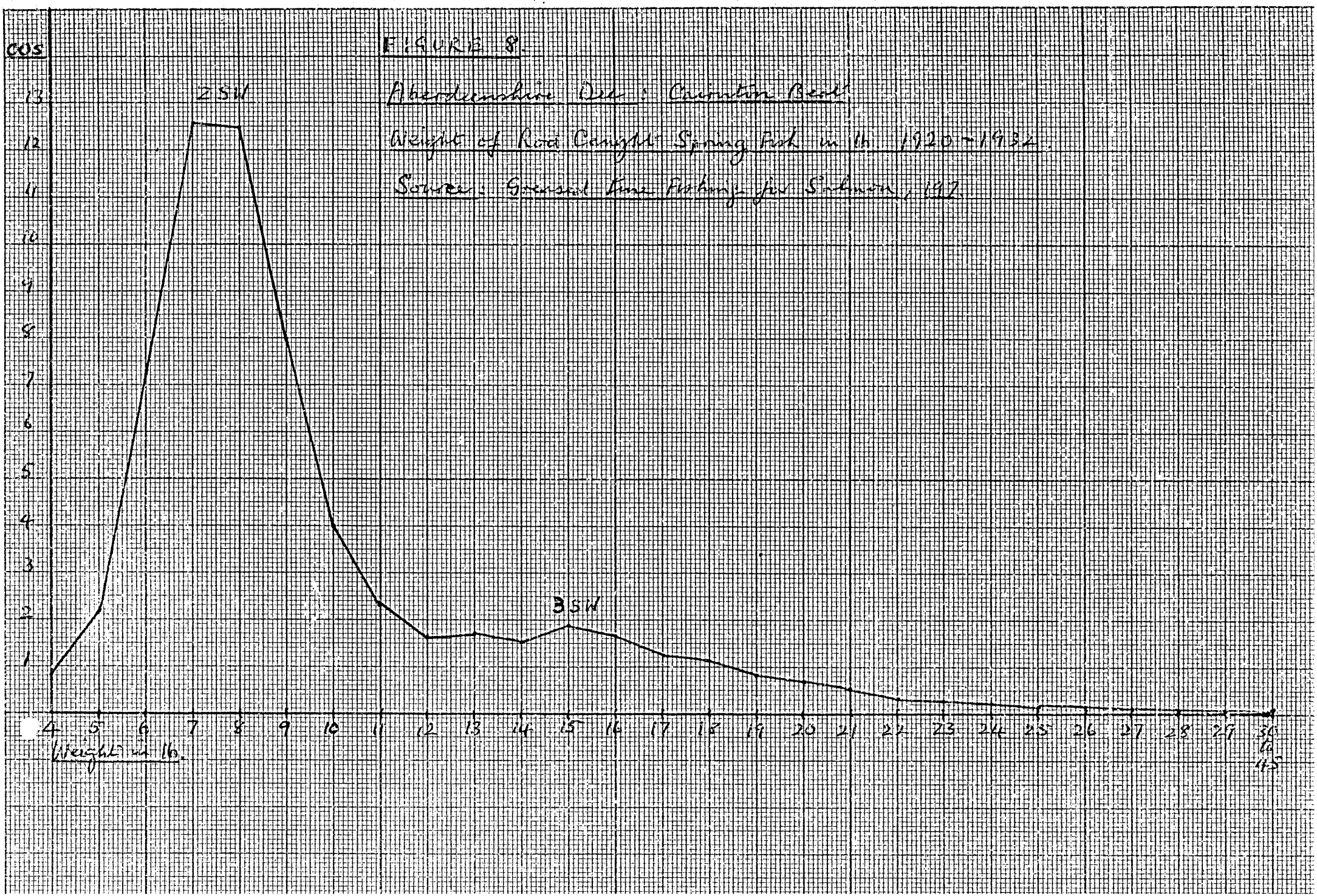


FIGURE 8.
Aberdeenshire Dist.: Carnation Beef
Weight of Road Camgilt Spring Pork in lb. 1920–1932.
Source: Second Annual Fatstock Show, 1932.
COS
2 SW
3 SW
Weight in lb.
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
lb.
45

Table 102

Aberdeenshire Dee: Grilse Average Annual Weights 1872-1950

Year	Av. Wt. Lb.	Year	Av. Wt. Lb.	Year	Av. Wt. Lb.
1872	4.62	1900	4.66	1928	3.64
73	4.78	01	3.96	29	3.70
74	4.40	02	4.79	30	3.99
75	4.28	03	4.09	31	4.35
76	4.29	04	3.94	32	4.10
77	4.87	05	4.58	33	4.24
78	4.31	06	4.18	34	4.81
79	4.28	07	3.52	35	4.62
80	4.38	08	3.68	36	4.62
81	4.33	09	4.19	37	4.24
82	4.37	10	3.75	38	4.11
83	5.09	11	4.08	39	4.56
84	4.54	12	4.16	40	4.40
85	4.90	13	4.17	41	4.85
86	4.12	14	3.98	42	4.25
87	4.08	15	4.35	43	4.14
88	4.54	16	3.23	44	4.46
89	4.11	17	4.04	45	3.90
90	4.68	18	3.90	46	4.06
91	4.95	19	4.23	47	4.64
92	4.29	20	3.71	48	4.57
93	3.58	21	3.73	49	4.30
94	4.46	22	4.04	50	4.09
95	5.14	23	4.00		
96	4.24	24	4.15		
97	4.17	25	3.78		
98	3.73	26	4.54		
99	4.54	27	4.13		

1921

In this seasonal investigation the sampling carried out for the Scottish Inspectorate of Salmon Fisheries was rather unsatisfactory in that, although the mains nets' catch of salmon was made in February, only 30 fish were sampled out of this month's catch. The total salmon and grilse catch of the Aberdeen Harbour Board's nets were, however, given, together with their average weights. Sources for the five years are provided at the end of the Dee analysis:

Table 103

Aberdeen Harbour Board: Catches and Average Weights 1921

	Salmon		Grilse	
	No.	Av.Wt. (Lb)	No.	Av.Wt. (Lb)
February	2,588	8.9	-	-
March	1,674	9.0	-	-
April	999	9.5	-	-
May	765	10.4	29	2.8
June	429	12.0	1,794	3.7
July	125	14.8	885	3.8
August	155	19.9	13	3.8
	6,735	9.7	2,721	3.7

No satisfactory breakdown of the spring catch of salmon into 2SW and 3SW is available, it being recognised that the large spring fish were inadequately represented in the sample.

Average weights in the sample, which amounted to 2,230 fish in all were:-

Table 104

Aberdeenshire Dee: Average Weights of Salmon and Grilse from Samples 1921 in lb.

	1+	Av.Wt.	2	Av.Wt.	2+	Av.Wt.	3	Av.Wt.	3+	Av.Wt.	Total
February	-	-	27	7.0	-	-	2	16.0	-	-	30
March	-	-	231	7.9	-	-	14	19.3	-	-	250
April	-	-	411	8.8	24	10.5	30	17.2	-	-	477
May	32	3.1	185	9.4	259	10.7	12	23.8	1	23.0	504
June	529	3.7	19	10.6	171	11.9	2	20.8	5	22.6	752
July	157	4.1	-	-	48	13.4	-	-	-	-	212
August	1	11.0	-	-	3	21.5	-	-	1	27.5	5
	719	3.8	873	8.7	505	11.4	60	19.0	7	23.4	2,230

The total column for 1921 includes 65 fish with one spawning mark and 1 fish with two spawning marks.

1922

The total nets' catches and weights were:-

Table 105

Aberdeen Harbour Board: Catches and Average Weights 1922

	Salmon		Grilse	
	No.	Av.Wt. (Lb)	No.	Av. Wt. (Lb)
February	959	10.3	-	-
March	784	10.1	-	-
April	759	9.8	-	-
May	438	10.6	36	2.7
June	145	12.3	844	3.8
July	296	15.1	1,328	4.0
August	537	18.1	170	5.4
	3,918	11.7	2,378	4.0

The sample analysis was:-

Table 106

Aberdeenshire Dee: Average Weights of Salmon and Grilse from Samples 1922 in lb.

	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
February	–	–	229	8.0	–	–	54	17.3	–	–	–	–	301
March	–	–	370	8.2	–	–	107	17.7	–	–	4	38.5	488
April	–	–	336	8.1	37	10.0	58	18.6	1	25.0	2	31.0	433
May	33	2.8	199	8.4	189	10.3	60	18.8	–	–	1	42.5	494
June	555	4.1	13	8.8	80	11.6	9	20.2	3	23.2	–	–	663
July	590	4.7	6	7.7	99	15.5	6	21.9	9	27.2	–	–	718
August	47	5.2	1	6.5	110	17.2	13	21.0	7	25.8	–	–	178
	1,225	4.4	1,154	8.2	515	13.0	307	18.3	20	26.0	7	36.9	3,285

The total column for 1922 also includes 51 fish with one spawning mark and 6 fish with two spawning marks.

1923

The total nets' catches and weights were:-

Table 107

Aberdeen Harbour Board: Catches and Average Weights 1923

	Salmon		Grilse	
	No.	Av.Wt. (lb)	No.	Av.Wt. (Lb)
February	845	8.9	-	-
March	1,177	8.7	-	-
April	801	9.3	-	-
May	606	10.2	19	3.8
June	429	12.3	1,253	3.9
July	267	15.9	1,194	4.1
August	212	19.8	52	5.0
	4,337	10.4	2,518	4.0

The sample analysis was:-

Table 108

Aberdeenshire Dee: Average Weights of Salmon and Grilse from Samples 1923 in lb.

	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
February	–	–	178	7.7	–	–	19	16.5	–	–	–	–	205
March	–	–	386	8.2	–	–	36	18.7	–	–	1	33.5	434
April	–	–	505	8.6	31	11.8	25	18.1	–	–	–	–	578
May	14	4.0	168	8.9	126	11.3	15	22.6	–	–	1	35.3	328
June	350	4.3	23	8.2	154	12.1	16	22.1	2	20.8	–	–	567
July	445	4.6	–	–	112	16.7	4	21.3	10	29.4	–	–	578
August	24	4.9	–	–	73	20.4	–	–	6	25.5	–	–	108
	833	4.4	1,260	8.4	496	14.2	115	19.3	18	27.1	2	34.4	2,798

The total column includes 70 fish with one spawning mark and 3 fish with two spawning marks. Also there was 1 No. 4 + SW fish that weighed 40.0 lb.

1924

The total nets' catches and weights were:-

Table 109

Aberdeen Harbour Board: Catches and Average Weights 1924

	Salmon		Grilse	
	No.	Av.Wt. (Lb)	No.	Av.Wt. (Lb)
February	2,110	9.6	-	-
March	2,094	9.5	-	-
April	2,325	10.0	11	2.4
May	858	10.6	149	2.9
June	432	12.4	2,173	3.8
July	219	15.3	986	4.5
August	301	18.1	240	6.2
	8,339	10.4	3,559	4.1

In this seasonal investigation an attempt was made to reconstruct the aging structure of the total nets catch in the form of percentages by the month and by the total for each age class:-

Table 110

Aberdeen Harbour Board: Aging Structure of Total Nets' Catch 1924

	1+	2	2+	3	3+	4	With S.M.	Total
February	-	93.60	-	6.40	-	-	-	100.00
March	-	89.30	-	8.74	-	-	1.96	100.00
April	0.47	78.59	12.80	6.51	-	-	1.63	100.00
May	14.80	36.74	46.38	2.38	-	-	0.70	100.00
June	83.41	2.84	12.71	0.38	-	0.12	0.54	100.00
July	81.83	-	15.77	0.58	0.91	-	0.91	100.00
August	44.36	0.37	49.53	0.74	3.33	-	1.67	100.00
	29.92	51.42	13.06	4.33	0.24	0.02	1.01	100.00

The table shows that 51% of the total netting catch consisted of small spring fish and that 30% of the catch was grilse. Big spring fish (3SW) amounted to only 4.33% of the total catch, and amounted to about 8% of the total catch of spring fish. The actual proportion of 3SW fish in the total catch may have been rather underestimated in this model.

The sample analysis was:-

Table 111

Aberdeenshire Dee: Average Weights of Salmon and Grilse from Samples 1924 in lb.

	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
February	–	–	–	8.0	–	–	–	15.3	–	–	–	–	125
March	–	–	–	8.4	–	–	–	17.9	–	–	–	–	309
April	7	2.5	–	9.1	–	11.6	–	22.2	–	–	–	–	373
May	84	3.1	–	8.9	–	9.9	–	20.5	–	–	–	–	334
June	423	3.8	–	9.4	–	11.1	–	21.4	–	–	–	26.0	603
July	389	4.8	–	–	–	14.9	–	22.0	–	27.0	–	–	487
August	118	6.3	–	9.0	–	18.3	–	26.3	–	25.8	–	–	288
	1,021	4.4	N.A.	8.7	N.A.	13.4	N.A.	19.8	N.A.	26.2	N.A.	26.0	2,519

The percentage of each age group in the 1924 sample were:-

1+	2	2+	3	3+	4	S.M.	Total
40.5	32.5	22.2	3.0	0.6	0.1	1.1	100.0

1925

The total nets' catches and weights were:-

Table 112

Aberdeen Harbour Board: Catches and Average Weights 1924

	Salmon		Grilse	
	No.	Av.Wt. (Lb)	No.	Av. Wt. (Lb)
February	2,636	10.0	-	-
March	2,614	10.4	-	-
April	1,444	10.8	-	-
May	811	12.0	38	2.6
June	288	12.9	2,038	3.7
July	106	15.8	1,345	3.9
August	127	18.0	66	5.2
	8,026	10.8	3,487	3.8

Yet again the basis of recording the investigation was varied. The sample amounted to 2,475 fish: 1,649 salmon and 826 grilse.

The number and percentage of each age group in the total nets catch for 1925 was estimated as:-

	1+	2	2+	3	3+	4	S.M.	Total
Numbers	3,487	6,138	774	834	10	19	251	11,513
Percentages	30.8	53.3	6.7	7.2	0.1	0.2	2.2	100.0

The sample analysis was:-

Table 113

Aberdeenshire Dee: Average Weights of Salmon and Grilse from Samples 1925 in lb.

	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
February	-	-	-	8.9	-	-	-	18.7	-	-	-	31.3	245
March	-	-	-	8.7	-	-	-	19.0	-	-	-	28.3	592
April	-	-	-	9.3	-	12.6	-	22.9	-	-	-	31.5	393
May	12	2.7	-	9.4	-	11.1	-	22.9	-	-	-	-	239
June	431	3.4	-	9.4	-	11.4	-	16.5	-	34.8	-	-	567
July	355	4.0	-	14.0	-	15.1	-	-	-	29.8	-	-	390
August	28	5.8	-	-	-	16.7	-	22.0	-	-	-	-	49
	826	3.7	N.A.	9.0	N.A.	12.2	N.A.	20.0	N.A.	32.3	N.A.	30.3	2,475

(Sources: Fisheries, Scotland, Salmon Fish, 1921 I (June 1922); Ditto 1924 III (October 1924); 1926 IV (September 1926); 1927 III (October 1927); 1931 IV)

Summary of Principal Variations in the Dee

It is seen from the detailed analysis 1921-25 that the Dee main salmon run had become very early by the 1920s. The 1922 season marked a partial reversion to the pattern of the migration at the opening of the period, as in the Spey for that year. From the early 1920s the average weights of salmon caught respectively by the sea nets and the river nets (Table 100) tended gradually to equalise into the 1930s, demonstrating the increased propensity for both sets of nets to catch the same class of early-running fish, as argued earlier.

The Cairnton beat analysis indicates a significant difference between the average weights of the 2SW fish caught at this rod fishing and the average weights of the same class of fish in the sampling analysis of the Scottish Inspectorate 1921-25. Excluding the fish of 2 and 3 lb caught in the Cairnton catches, and counting 75% of the 12 lb fish and 50% of the 13 lb fish as 2SW spring fish, along with all fish weighing 4-11 lbs, the comparison is:-

Table 114
Aberdeenshire Dee: Comparison of Rod Catch Weights with Nets' Catch Weights
(Sources: Tables 81 and 101)

	1921	1922	1923	1924	1925
Cairnton 2SW average (lb)	7.3	7.6	7.4	7.9	8.4
Scottish Inspectorate 2SW average (lb)	8.7	8.2	8.4	8.7	9.0

It is possible that the Cairnton classification by exact lb. units is rather at fault, but even allowing for a maximum fault of

½ lb (e.g. the average difference between 7.6 and 8.4 lb for an 8 lb fish and 7.0 and 7.9 for a 7 lb fish, and etc.) the variation is still significant, and is probably accountable by the fact that the rods at Cairnton would have caught 2SW fish of earlier-running stock on average than the nets, and particularly in the netting samples employed, including considerable numbers of fish from stock running before the nets commenced to work.

The mean weight of the 3SW fish at Cairnton peaked at 15-16 lb, indicating considerable quantities from the earliest-running of this class of fish also, employing the average weights for 3SW fish by month in 1921-25 analysis as a comparison.

The table of average grilse weights by year 1872-1950 indicates that over the great grilse period 1881-1895 there was a distinct though not invariable tendency for the grilse to be of heavier than running-average weights in the seasons of particularly heavy grilse migration, for example in the seasons of 1883, 1885, 1888, 1891 and 1895, though not in 1881, 1887 or 1892, these eight years being the seasons over 1881-1895 when the total catch of grilse by the combined nets of the Aberdeen Harbour Board exceeded 10,000 each season. From 1896, however, as the Dee grilse migration declined the average weight of the grilse declined, the years in which the average weight of the grilse fell below 4 lb gradually increasing. This decline of average weight accelerated from 1907 and the average grilse weights remained low until the 1930s, when a modest improvement in the quantities of grilse was matched by a corresponding modest improvement in the average weights.

From the rather limited evidence available in the 1921-25

analysis the 3SW spring stock as a proportion of the total spring stock was very modest, amounting to only a few percent on average, though varying. As in the Spey, the proportion of 3SW fish tended to be greatest in February and March, declining significantly in April, but rather tending to improve proportionately as the spring run declined during May and June. The numbers of fish older than 3SW were insignificant in the Dee at the period.

The estimated analysis of the total nets catch by age-class for the seasons of 1924 and 1925 show that the Dee was a young-fish river in that c. 50% of the catch was of the 2SW class and c. 30% of the 1SW class, the catch of 2 + SW summer fish by the early 1920s being small. Since the overall salmon run had by that time become so early it is clear that the true proportion of 2SW small spring fish in the total migration must logically have been greater than 50%, since an important share of it would have migrated before netting commenced. Also the nets would have taken a proportionately greater part of the grilse run during the dry summer than it would of the early-spring migration at a time of high river levels.

As regards the grilse run, by the early 1920s it was an early summer run, the main migration taking place during June (except for 1922 when the grilse run, as well as the salmon, reverted to the pattern of an earlier era, taking place in July). The grilse became lighter not only because the run became earlier but also because, as in the Spey and other rivers at the same period, the incremental average weights of the July and August grilse increased only very marginally over the June weights.

The Tweed

Calderwood's "Salmon Rivers of Scotland" (1909, 20) includes a description of some big catches of late-running summer fish in the Tweed early this century, before the main salmon run became much earlier, when autumn salmon fishing with the rod was highly productive given suitable water conditions. The individual fish weights are given for one daily catch:- "Then on 20th November (1903) came his greatest day, when he (i.e. George M'Culloch) killed 19 fish, in the Garden and Peat Pools, averaging 20½ lb. The weights were:- 39, 28, 24, 24, 24, 23, 21, 20, 20, 20, 19, 19, 18, 17, 17, 16, 16, 15 and 14 lb."

The ages would probably have been:

14 - 24 lb:	2 + SW
28 lb:	large 2 + SW or small 3 + SW fish
39 lb:	3 + SW

During the subsequent decade 1911-1920 the whole structure of the salmon run began to change, the main runs gradually becoming much earlier. Three scientific papers of the Scottish Inspectorate of Salmon Fisheries dating from 1923, 1932 and 1933 offer information about fish average weights in the seasons of 1921, 1929 and 1930.

1921

In this season a sample of 233 fish were provided by the Berwick Salmon Fisheries Co. Ltd from their lower river nets fishings during the months of March and April. The ages and related average weights were:-

Table 115

Tweed: Average Weights of Salmon from Samples 1921 in lb.

(Source: Fisheries, Scotland, Salmon Fish, 1921, No. III (Feb. 1923)

	2SW	Av.Wt.	2+SW	Av.Wt.	3SW	Av.Wt.	Total
March	118	7.6	-	-	6)	16.6	124
April	99	8.5	1	N.A.	9)		109
	217	8.0	1	-	15	16.6	233

1929

In this season a much bigger sample of 2,293 fish was obtained from the same source covering every month of the netting season (15 February to 14 September). The ages and average weights were:-

Table 116

Tweed: Average Weight of Salmon and Grilse from Samples 1929 in lb.

(Source: Fisheries, Scotland, Salmon Fish, 1932 No. III)

Sea Age	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	Total
February	-	-	32	7.8	-	-	2	15.5	-	-	34
March	-	-	205	7.5	-	-	41	15.5	-	-	246
April	1	1.5	195	7.9	-	-	20	15.4	-	-	216
May	-	-	274	8.5	67	9.9	18	17.8	-	-	359
June	27	4.6	83	9.2	207	10.2	10	21.1	2	24.6	329
July	114	4.8	11	8.8	331	13.6	5	19.8	11	22.7	472
August	9	5.4	-	-	345	16.9	-	-	3	26.3	357
September	1	8.3	-	-	217	17.5	-	-	4	23.2	222
	152	4.8	800	8.1	1,167	14.5	96	16.7	20	23.6	2,235

(The netting season in Tweed is from 15 February to 14 September.)

There were, in addition, 56 fish with one spawning mark and 2 with two spawning marks in 1929.

1930

The sample in the 1930 season amounted to 2,532 fish, and the ages and average weights were:-

Table 117

Tweed: Average Weights of Salmon and Grilse from Samples 1930 in lb.

(Source: Fisheries, Scotland, Salmon Fish, 1933 No. III)

Sea Age	1+	Av.Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	Total
February	-	-	79	7.5	-	-	8	15.8	-	-	87
March	-	-	364	7.7	-	-	55	15.3	-	-	419
April	3	2.4	229	8.3	10	9.5	29	14.6	-	-	271
May	6	2.5	261	9.0	146	9.5	20	17.3	2	20.1	435
June	73	4.0	24	8.4	259	9.9	18	20.4	6	20.9	381
July	128	4.8	3	10.3	305	12.3	2	19.0	20	23.2	458
August	89	5.7	-	-	206	15.4	-	-	33	24.0	328
September	24	6.3	-	-	60	16.5	-	-	8	27.4	92
	323	4.9	960	8.2	986	12.1	132	16.2	69	23.8	2,471

There were also 61 fish with one spawning mark in 1930.

The main salmon run terminated much earlier in 1930 than in 1929:-

Table 118

Tweed: 2 + SW Catch Proportions by Months

(Source: Table 79)

	1929	1930
April	-	1.1
May	5.7	15.8
June	17.7	26.9
July	28.4	35.6
August	29.6	13.7
September	18.6	6.9
	100.0	100.0

Summary of Principal Variations in the Tweed

The 1921 sample was restricted to the months of March and April. In 1929 and 1930 the monthly samples analysed were made to coincide numerically proportionately and exactly with the total numerical netting catches by month. In the Tweed the netting season runs from 15 February until 14 September.

In the 1929 season there was still a good run of late summer salmon right up to the end of the netting season, largely 2 + SW, long after such a migration had declined into insignificance in Spey and Dee. In 1930, however, the main salmon run terminated much earlier than in 1929, being largely over by the end of July, the run as a whole being earlier: in 1929 51% of the total netting catch comprised 2 + SW fish as compared to 35% 2SW fish and 4% 3SW fish; but in 1930 the netting catch of 2SW and 3SW fish combined exceeded

the catch of 2 + SW fish by 4 percentage points (i.e. of the total netting catch, not of the sample).

It was previously argued that this radical change was consistent with the salmon run as a whole becoming earlier during the 1930s, resulting in a correspondingly vastly improved catch by the spring anglers, benefitting from both a greater proportion of the salmon running past the nets in the high river levels of the early spring together with a greater proportion of the stock migrating before the netting commenced on 15 February.

The average weight of the salmon of the late-summer run in 1930 also displayed a significant decline month on month as compared to 1929, similar to comparative events in the Spey in 1901-03 as against the 1920s and 1940s, and also in other rivers, though not significantly in the Dee.

The Tweed grilse run was rather later at the period than in the Spey, and much later than in the Dee. The grilse run was very poor in 1929 (only 6.6% of the total netting catch), but in 1930 it was vastly increased (46% of the total netting catch) as it was everywhere on the Scottish east coast. In 1929 the grilse netting catch was as to 18% in June, 75% in July and 6% in August, as compared respectively to 4%, 79% and 15% in 1930. Not only were the average weights of the grilse significantly greater than in the Spey and the Dee but the incremental average weights of grilse month on month were progressive, particularly in 1930, as compared to the more static grilse average weights in Spey and Dee during the 1920s. However, exactly similar years are not available for comparison in the Tweed.

Overall the spring fish of the 2SW class were small, of a lighter

average weight than the Dee small spring fish, and considerably smaller than the Spey average weights for 2SW fish. Similarly, the average weight of the 3SW fish was also significantly smaller in the Tweed than in either of the other two districts. This comment does not apply to the Tweed summer salmon and grilse, however, as these classes were as heavy or heavier than for the other two districts, and in the case of the grilse distinctly more so.

The Tay

Investigations into the salmon stock of the Tay were carried out by the Scottish Inspectorate during the seasons of 1930 and 1934 using net-caught samples provided by the Tay Salmon Fisheries Co. Ltd. As with the Tweed investigations, the monthly samples analysed were made to coincide proportionately and exactly by number with the total netting catches by month.

The netting season in the Tay is from 5 February to 20 August.

1929

The total sample amounted to 1,795 fish. These were all salmon. Through error the grilse catch was not included. The fish ages and related weights are:-

Table 119

Tay: Average Weights of Salmon and Grilse from Samples 1929 in lb.

(Source: Fisheries, Scotland, Salmon Fish, 1934, No. V)

Sea Age	2	Av.Wt.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
February	23	8.4	-	-	115	19.3	-	-	3	34.7	141
March	55	9.6	-	-	245	20.0	-	-	6	35.2	306
April	60	10.9	17	12.1	131	21.0	-	-	6	34.6	214
May	37	10.7	141	13.0	53	22.9	8	26.9	1	32.0	240
June	1	7.8	122	13.8	7	22.1	6	29.5	1	35.5	137
July	-	-	269	17.0	21	26.8	62	30.0	-	-	352
August	-	-	242	18.1	-	-	48	30.4	-	-	290
	176	10.1	791	16.0	572	20.6	124	29.9	17	34.7	1,680

There were in addition 115 fish with one spawning mark in 1929.

An analysis of the total nets' catch by month of the Tay Salmon Fisheries Co. in percentage form was reproduced in the paper for 1929, and this did include the grilse catch. Since the Tay, unlike the Spey, Aberdeenshire Dee and Tweed, was not considered in the statistics of chapter two, the netting analysis is reproduced in full, because the return migration pattern in the Tay is markedly dissimilar to any of the rivers discussed earlier in this section, except the Forth:-

Table 120
Tay: Aging Structure of Nets' Catch 1929
(Source: Fisheries, Scotland, Salmon Fish, 1934, No. V.)

	1+	2	2+	3	3+	4	S.M.	Total
February	-	15.0	-	75.2	-	2.0	7.8	100.0
March	-	17.0	-	75.6	-	1.9	5.5	100.0
April	-	26.1	7.4	57.0	-	2.6	6.9	100.0
May	-	14.7	56.0	21.0	3.2	0.4	4.7	100.0
June	21.2	0.5	66.3	3.8	3.3	0.5	4.4	100.0
July	56.9	-	30.5	2.4	7.0	-	3.2	100.0
August	49.0	-	39.7	-	7.9	-	3.4	100.0
% of Total Catch	31.9	6.7	30.0	21.7	4.7	0.6	4.4	100.0

1934

The total number of sets of scales in the sample was 2,329, including grilse. Average ages and weights were:-

Table 121

Tay: Average Weights of Salmon and Grilse from Samples 1934 in lb.

(Source: Fisheries, Scotland, Salmon Fish, 1935, No. V.)

	1+	Av. Wt.	2	A.W.	2+	A.W.	3	A.W.	3+	A.W.	4	A.W.	Total
February	-	-	74	10.7	-	-	138	20.9	-	-	2	35.5	214
March	-	-	91	10.5	1	10.5	56	21.4	-	-	-	-	148
April	-	-	100	11.5	26	12.3	23	22.7	-	-	-	-	149
May	-	-	52	12.4	137	14.1	21	26.8	1	21.5	2	40.5	213
June	127	5.8	5	10.2	202	15.4	6	25.5	15	28.3	-	-	355
July	260	6.2	1	13.0	402	17.2	5	24.3	18	26.3	1	28.0	687
August	170	7.5	-	-	322	18.8	-	-	4	28.8	-	-	496
	557	6.5	323	11.2	1,090	16.8	249	21.9	38	27.3	5	36.0	2,262

There were also 64 fish with one spawning mark and 3 fish with two spawning marks.

The total nets' catch by month in percentage form for the 1934 season was:

Table 122

Tay: Aging Structure of Nets' Catch 1934

(Source: Fisheries, Scotland, Salmon Fish, 1935, No. V.)

	1+	2	2+	3	3+	4	S.M.	Total
February	-	32.6	-	60.8	-	0.9	5.7	100.0
March	-	57.6	0.6	35.5	-	-	6.3	100.0
April	-	65.0	16.9	14.9	-	-	3.2	100.0
May	0.5	23.3	61.7	9.5	0.5	0.9	3.6	100.0
June	35.0	1.4	55.6	1.7	4.1	-	2.2	100.0
July	53.0	0.1	43.4	0.5	1.9	0.1	1.0	100.0
August	51.6	-	44.9	-	0.6	-	1.9	100.0
% of Total Catch	35.9	11.7	39.4	9.0	1.4	0.2	2.4	100.0

Summary of the Principal Variations in the Tay

There were significant differences, as has been seen, in the return-migration patterns in Spey, Dee and Tweed, but compared to the Tay all three appeared to have much in common.

In the Tay at the period, according to the seasonal investigations of 1930 and 1934, the early spring run consisted substantially of 3SW fish, together with a not insignificant residual stock of 4SW fish as compared to the other three rivers. In fact, these characteristics are known to have been true from other sources, particularly angling records.

The run of 2SW fish hardly became significant before March or April, and the spring run of 2SW fish was not heavy compared to either the total migration in the Tay or to the migration of this class of fish in Spey, Dee or Tweed. The main run of the 2SW fish, in the form of 2 + SW stock, was actually in July and August. This characteristic is probably due to the singular nature of the Tay watershed, divided as it is by the great Loch Tay into distinct upper and lower river systems, in which it is similar to the Ness which also enjoyed not dissimilar migrations of largely 3SW winter and early spring fish belonging to the upper system (above Loch Ness) and largely 2 + (and 1 + SW) summer-running fish of the lower system.

In February and March of the 1929 season c. 75% of the total netting catch consisted numerically of 3SW fish and c. 2% of 4SW fish. As late as April 57% of the catch was of 3SW age and 2.6% of 4SW. The run of these heavy fish appeared to peak in March in 1929. In 1934 the percentage of 3SW fish in the total netting catch was c. 61% in February and c. 36% in March, declining rapidly thereafter, with c. 1% and nil respectively of 4SW fish. However, the numbers of 3SW fish were much greater in the nets' catch during February than in any other month, and this may have indicated that a large migration of this stock occurred before the netting season opened on 5 February. (Large catches of heavy fish were frequently made at the period by the rods in the lower river system up to and including Loch Tay at the opening of the rod season on 15 January. Some of these fish even at that early date had lost their sheen, indicating that they had been running since the previous autumn).

Allowing for the fact that the netting season closed on 20 August,

the migration of 2 + SW fish, and of the 2SW stock as a whole, peaked during July and August. 2SW spring fish amounted to only 6.7% of the total nets' catch in 1929, and 11.7% in 1934, whereas the percentage proportions of 2 + SW fish were respectively 30% and 39%. The grilse run was a late one for the period in comparison with the Spey, Dee and even the Tweed. In 1929, according to the total nets' catch, 4.6% of the grilse migration occurred in June, 59.8% in July and 35.6% in August up to 20th, and the corresponding percentages in 1934 were 12.7, 49.2 and 38.0.

The average weight of all classes of fish, and of the grilse particularly, was high in comparison with all rivers previously considered.

The Forth

During the period 1900-1940 considerable quantities of the fish caught at the Elie fishery of this river, the full statistics for which were given earlier, were sold locally, and their individual weights recorded. Many of these fish were grilse, but including some summer salmon. The salmon weight groupings clearly indicate that the salmon were of the 2SW age group, excepting one June fish of 19 lb assumed to be a 3SW fish, and a few very small fish sold as salmon by the netsmen that were probably grilse. These and the 19 lb fish were removed from the following analysis. After making this minor adjustment there nevertheless remains a noticeable difference between the average weights of the salmon during the opening decade of the period and the average weights in the 1920s and 1930s. Mr. J. Stansfeld, Director of Joseph Johnston & Sons Ltd of Montrose, whose records these are, is of the opinion that it was the habit to

sell locally the smaller salmon only. However, assuming this habit was constant, the comparison of average weights still holds:-

Table 123

Forth: Summer Salmon Average Weights at the Elie Fishery

	1900	1901	1902
June	9.2 lb	9.6 lb	10.5 lb
July	14.0 lb	12.2 lb	12.5 lb
August	15.3 lb	14.6 lb	15.0 lb
	1920	1921	1922
June	7.9 lb	8.9 lb	8.3 lb
July	11.3 lb	11.1 lb	10.3 lb
August	-	-	13.5 lb

There are no August averages in 1920 and 1921 because, whereas during the opening decade there were many salmon caught in August, by the 1920s there were few, excepting the rather unusual season of 1922 which, in the Forth as in other rivers, was something of a throw-back to an earlier period.

The grilse average weights were:-

Table 124
Forth: Grilse Average Weights at the Elie Fishery

	1900	1901	1902
June	4.4 lb	3.8 lb	4.1 lb
July	5.1 lb	4.4 lb	5.3 lb
August	5.5 lb	5.2 lb	6.4 lb
	1920	1921	1922
June	3.5 lb	4.3 lb	4.0 lb
July	4.2 lb	4.3 lb	5.1 lb
August	-	-	5.9 lb

By the 1920s the grilse run had become earlier, with few August grilse in many seasons, though not in 1922. In the 1921 season is seen the lack of incremental growth of the July grilse against the June grilse, conspicuous during the 1920s in other rivers.

It should be emphasised that the total sample numbers for grilse are modest and for salmon small.

The Conon

The five rivers previously considered are all major ones of the east coast extending from the south coast of the Moray Firth down to Tweed in the Borders. In 1927 Jock Menzies investigated the Conon on the northern shores of the Moray Firth. As previously stated most of the rivers extending from the Beauly all the way north and round to the Naver and Borgie share regional characteristics that do not vary intercyclically to the same degree as most of the rivers south from the Moray Firth. They tend among other things to be young

fish rivers, 1SW and 2SW stock, with proportionately good quantities of grilse even in a generally salmon-dominated cycle. The following Table summarises the age structure of the return-migration in 1927 from the nets' catch sample analysis:-

Table 125

Age-Structure of the River Conon Nets' Catch Sample 1927

Sea Age	1+SW	2SW	2+SW	3SW	3+SW	4SW	Spawning Mark	Total
Percentages	54.1	20.93	17.90	0.94	0.33	0.03	5.77	100

The return-migration was virtually over for the season by the first week of August.

8. Variations of the Return-Migration in other Countries

It is only during the period 1900-50 that indications began to appear in any significant number from a variety of sources - some of then statistical but most of them merely descriptive - that the variations in return-migration occurring in Scotland periodically have an echo, probably far more than an echo, in other countries that enjoy the Atlantic salmon, and not only in the British Isles.

Before the turn of the century, or thereabouts, too little was known of the true natural history of the salmon for the experiences of different countries to be related with any degree of confidence. However, the great decline of grilse in Scotland during the 1850s and 1860s was certainly reflected by comment about a correspondingly great decline of grilse in England. This decline had become so apparent by 1876 that Frank Buckland, Inspector of Salmon Fisheries for England and Wales, observed in his Report for that year: "The reason must be

general, as the summer migration of the grilse seems to be altered, and altering, all over the country." In his book "Salmon Problems" J.W. Willis Bund commented on the position: "The summer run of grilse used always to be looked forward to by fishermen as forming the most profitable part of the salmon harvest, but for some years past there has not been, or at least the fishermen say there has not been, the regular summer run there used to be, and various attempts have been made, all equally unsatisfactory, to explain it..... Yet the fact remains that all over England the fishermen complain that the run of grilse is not what it used to be. Fishermen always talk in this way, and I am tempted to doubt if, after all, the run of grilse before 1866 was really so regular or so large as it is often represented to be."

Following the turn of the century comment became more precise: "I may mention in passing that in certain large rivers of Norway, as apparently also in the Rhine, grilse are or have become comparatively scarce. In the returns respecting the Dutch salmon fisheries (i.e. of the Rhine) I find that in 1873 the grilse showed, in the total catch, a percentage of 57; that for a considerable period of years after that date the grilse formed 23 to 24 per cent. In 1903 the grilse formed 6 per cent." (Report of the Fishery Board for Scotland, 1908, Appendices, 3). In other words, the Dutch fisheries experienced a decline of grilse in their catches at broadly the same times as the decline in Scotland.

The Billingsgate market returns for Scotland were inadequate from about 1900 due to a changing pattern of distribution for Scottish fish, as described earlier. However, this did not apply to Ireland, from which country a large proportion of the total catches were sent to

Billingsgate, at least until after the second World War. The average annual number of boxes received at Billingsgate from Ireland over the period 1905-1921 were:-

Table 126

Numbers of Boxes of Irish Salmon and Grilse sent to Billingsgate Market 1905-21

(Source: Salmon and Trout Magazine, 1922, Appendix 1, 128.)

	1905-9	%	1910-14	%	1915-19	%	1920	%	1921	%
Jan-May	2,613	38	3,792	49	3,591	57	4,130	68	5,735	73
June-Sept.	4,218	62	3,918	51	2,754	43	1,954	32	2,162	27
	6,831	100	7,710	100	6,345	100	6,084	100	7,897	100

There was a great decline of summer fish over the period, together with a substantial increase of spring fish culminating, as in Scotland, with a big early run in the season of 1921. (Salmon and Trout Magazine, 1922, Appendix 1, 128.)

In England the corresponding position was:

Table 127

Numbers of Boxes of English Salmon and Grilse sent to Billingsgate Market 1905-21

(Source: Salmon and Trout Magazine, 1922, Appendix 1, 127.)

	1905-9	%	1910-14	%	1915-19	%	1920	%	1921	%
Jan-May	1,194	35	1,733	34	1,071	39	757	47	1,928	48
June-Sept.	2,227	65	3,300	66	1,672	61	847	53	2,118	52
	3,421	100	5,033	100	2,743	100	1,604	100	4,046	100

As in Scotland and Ireland there was a particularly significant

numerical decline of summer fish from 1915-19, together with a gradual increase of spring fish. The decline of summer fish is not so marked as in Scotland or Ireland, probably because there were not so many grilse in the southern districts to begin with in 1905-09, but proportionately more June and July 2 + SW fish. (The 2SW stock is not generally so early-running in most southern English and Welsh districts as in either Scotland or Ireland, the main migration of 2SW/2 + SW fish during 1900-1950 usually being between middle or late April and the middle of July. On the other hand, there were greater proportions of 3SW early spring fish in many districts.)

There are indications that the factors causing the variations of return-migration in Scotland also influence at the same time not only the other countries of the British Isles but also other European countries. Indeed, since the great increase of grilse combined with a decline of older stock experienced in Scotland and Ireland during the 1960s was also reported in some of the Canadian rivers such factors may be to some degree general in all countries having the Atlantic salmon, whether in Europe or North America.

It had been the original intention to write a history of variations in the return migration over 200 years for the whole of the British Isles, but sound statistical information was found to be negligible for English and Welsh rivers on a continuing basis over long periods of time. A fellow angler whose family had owned a net fishing on the Yorkshire Ouse for centuries offered access to the old hand-written daybooks, and analysis was undertaken of three day-books covering the periods 1884-1897 (14 years), 1908-1912 (5 years), and 1926-1938 (13 years). A single graph (Figure 9) has been prepared

incorporating all three periods, followed by the numbers of fish caught in each month for all these seasons (Table 128). There is no distinction between salmon and grilse. The net-fishing in question is, or was, the top one on the Ouse at the head of the tide below York at Naburn Loch. This meant that it was a good spring fishing, but entirely dependent on floods for summer fishing, which accounts for the great variations in the summer catches from nothing to many hundreds per season.

It is seen that, just as in most of the major Scottish rivers, during the late 19th century the main runs were very late and would certainly have continued in force after the netting finished at the end of August. The growth of the spring run was most obvious from the early years of the century. Most of the spring fish were of 3SW age until April. In the 1880s and 1890s the big August runs were a combination of salmon and grilse. In the 1930s the big August runs were very largely of grilse.

As with the Forth, pollution (of the Humber estuary) became so bad during the last war that the run much deteriorated. There is still a salmon run into the Ouse system, quite good in some years. Most if not all the fish belong to the river Ure. The estuary is much cleaner but water-abstraction is greatly increasing.

FIGURE 4

Yorkshire Ouse : Naburn Lock - York

Upper Estuary Net Fishing

Source : D. Dentman Esq. Peterborough

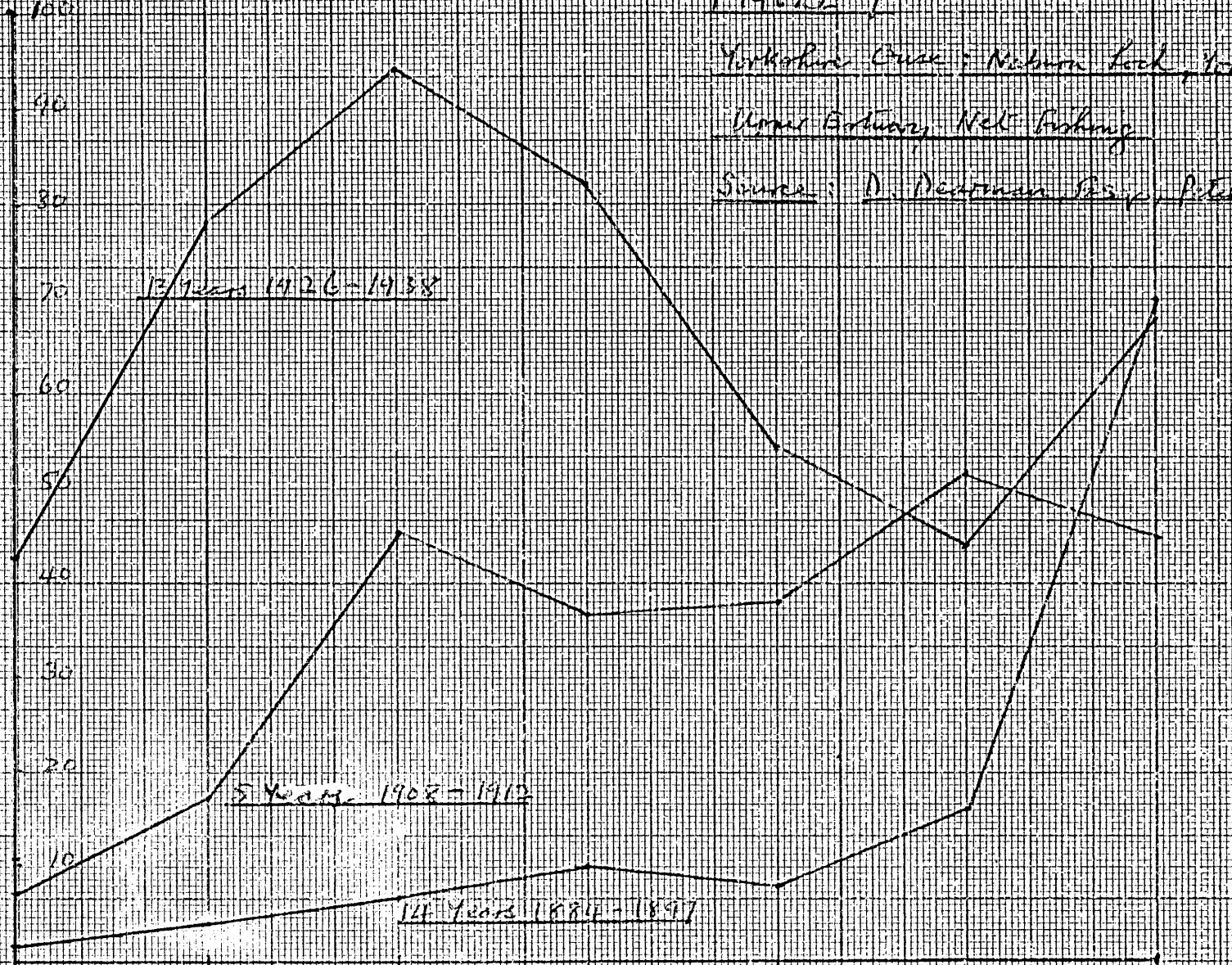


Table 128

Net Catches in the Yorkshire Ouse at Naburn Loch, York 1884-1938

(Source: D. Dearman, Esq., Peterborough.)

	Feb	Mar	Apr	May	June	July	Aug	Total
1884	7	20	17	22	4	24	33	127
1885	2	5	13	29	35	2	148	234
1886	-	3	4	20	31	109	152	319
1887	-	3	7	11	8	-	-	29
1888	3	5	8	7	10	40	122	195
1889	6	2	13	6	3	4	54	88
1890	1	3	1	3	-	19	108	135
1891	2	3	5	11	6	10	133	170
1892	1	4	6	15	6	12	45	89
1893	-	2	5	-	-	2	12	21
1894	-	1	1	2	4	1	10	19
1895	-	-	2	1	-	-	149	152
1896	-	1	1	4	1	2	-	9
1897	-	1	8	8	2	2	15	36
Av. No.	1.6	3.8	6.5	9.9	7.9	16.2	70.1	115.9
1908	5	5	29	17	20	4	35	105
1909	4	2	41	77	37	166	135	462
1910	3	16	52	51	15	26	-	163
1911	11	31	40	14	-	-	-	96
1912	12	32	63	24	85	96	53	365
Av. No.	7.0	17.2	45.0	36.6	31.4	58.4	44.6	238.2
1926	23	38	24	2	16	9	3	115
1927	47	101	130	107	60	111	28	584
1928	76	232	184	151	140	32	-	815
1929	8	4	14	27	-	-	-	53
1930	46	132	117	98	23	4	34	454
1931	27	30	52	37	35	71	237	489
1932	17	28	64	102	133	161	383	888
1933	91	92	62	73	19	-	-	337
1934	67	122	152	137	-	-	-	478
1935	45	71	110	63	54	-	-	343
1936	59	94	249	153	118	164	187	1024
1937	8	25	56	119	101	2	-	311
1938	37	47	6	-	10	12	-	112
Av. No.	42.4	78.2	93.8	82.2	54.5	43.5	67.1	461.8

CYCLICAL VARIATIONS IN THE RETURN

MIGRATION OF SCOTTISH SALMON

BY SEA-AGE

c. 1790 TO 1976

SECTION IV: 1952 - 1976

Introduction

It had been the intention to provide a full analysis of the by river district period 1952-76 from the records of the Department of Agriculture and Fisheries for Scotland, which has collected details of all salmon and grilse legally caught by net and rod since the 1952 season via its statutory obligation under the 1951 Salmon Act. The present Inspector of Salmon Fisheries for Scotland, Mr. R.B. Williamson had indicated his willingness in principle to provide this information. However, at the time it was required (summer 1981) the Department was still in the course of computerising the whole of the records since 1952 by district, by number of salmon and of grilse and by average seasonal weight of each. It could not therefore be made available without undue delay.

In view of this the catches of salmon (2SW and older fish) and grilse (1 + SW fish) are given in outline hereinafter (Table 129) in the form of annual total Scottish catches of salmon and grilse, with a view to indicating the main changes in return-migration by sea-age that have taken place over the 25 year period 1952-1976. The nets' catches only are subsequently analysed (Table 130) because it is these catches that have been adjusted for the "grilse error" (to be explained later). The rods' catches have not been adjusted to take into consideration this factor. All this outline information on the catches has been provided by the Department itself, either directly or indirectly.

The position is, then, that full details of the return-migration by number, sea-age and by average seasonal weight of salmon and grilse will be produced in a computerised form by district for the

whole of Scotland in due course by the Department, and when these become available it will be possible to compare return-migratory variations by sea-age and by average weight of salmon and grilse over 1952-1976 with the information offered in this thesis on the various cycles and their characteristics over c.1790-1951.

It would hardly be possible to reconstruct the period 1952-1976 statistically without reference to the Department's records:- Whereas many commercial salmon fishing sources are prepared to grant access to their old records, most are not willing to offer information on recent catches.

Variations in Return-Migration by Sea-Age 1952-1976

The principal changes that have occurred in the return-migration by sea-age since 1952 are known, and original research is not needed to make clear their outline. Four tables based on information provided by the Department of Agriculture and Fisheries for Scotland are offered in order to demonstrate the main variations in the return-migration during the period. Note that all tables are divided into "salmon" and "grilse." The grilse are 1SW fish only, but the salmon are of all ages from 2SW through to, theoretically at least, 5SW. Obviously, the great majority of the salmon are of 2SW age, and there are few fish over 3SW age. Observations on variations in the quantities of 3SW and older fish during the period will be made subsequently.

Table 129

Total Numbers of Salmon and Grilse Caught by Net and Rod as Returned by the Fisheries over 1952-1975 Inclusive

(Source: Department of Agriculture and Fisheries for Scotland.)

	Salmon	5 Year Average	Grilse	5 Year Average	Total Catch
1952	235,324		150,225		
1953	212,195		142,120		
1954	256,258	230,334	117,066	132,442	362,776
1955	250,514	(64%)	136,099	(36%)	(100%)
1956	197,378		116,698		
1957	217,445		196,775		
1958	222,760		196,768		
1959	269,976	218,071	114,950	169,630	387,701
1960	200,340	(56%)	183,409	(44%)	(100%)
1961	179,835		156,247		
1962	212,784		281,296		
1963	267,140		166,879		
1964	268,783	239,270	285,537	233,757	473,027
1965	219,937	(51%)	214,191	(49%)	(100%)
1966	227,704		220,882		
1967	261,491		344,929		
1968	213,931		213,870		
1969	209,952	204,148	348,777	282,744	486,892
1970	174,297	(42%)	243,437	(58%)	(100%)
1971	161,069		262,707		
1972	210,384		249,736		
1973	229,388	208,745	291,440	258,463	467,208
1974	185,471	(45%)	278,423	(55%)	(100%)
1975	209,738		214,251		

The catches for 1976 in this form are not available.

It is seen from these catches that there was a steady movement to grilse as a percentage of the total numerical catch beginning in 1957 and culminating during the quinquennial period 1967-1971, coincident with an increase in the total numerical return-migration over the same period.

However, the Department of Agriculture and Fisheries for Scotland became aware that, contemporaneous with their numerical enhancement, the weights of the grilse had increased equally dramatically, particularly from the 1962 season. A consequence of this development had been that many of the heavier grilse were mistakenly classed by the netsmen as summer salmon (i.e. 2 + SW instead of 1 + SW). In order to effect a theoretical rectification of this mis-classification, Dr. K.A. Mitchell, of the Freshwater Fisheries Laboratory at Pitlochry has employed a statistical method applying frequency distributions and resemblance coefficients to the summer catches as a whole over the full period 1952 to 1976 and produced corrected grilse and summer salmon catch figures for the period 1962 to 1976. By the nature of such an exercise the corrected values cannot be exact, but they are certainly much nearer the true figures of salmon and grilse than the official returns incorporated into Table 129. The revised figures identify closely with the age-classes obtained by scale-analysis carried out independently over the period 1969-1976 at a number of net-and-coble fisheries.

The statistical method to effect a theoretical rectification was applied only to the netting catches, and the revised values are incorporated into Table 130.

Table 130

Scottish Net Fisheries Catches of Salmon and Grilse
1952-76 (Revised)

(Source: Department of Agriculture and Fisheries for Scotland.)

	Salmon	5 Year Average	Grilse	5 Year Average	Total Catch
1952	200,902		145,091		
1953	167,692		135,509		
1954	202,893	185,591	113,063	126,987	312,578
1955	205,415	(59%)	131,970	(41%)	(100%)
1956	151,051		109,300		
1957	154,824		186,978		
1958	162,797		192,588		
1959	222,455	163,486	112,518	165,108	328,594
1960	148,482	(50%)	183,431	(50%)	(100%)
1961	128,872		150,027		
1962	125,136		296,477		
1963	183,061		171,900		
1964	148,117	140,485	326,348	255,742	396,227
1965	131,821	(35%)	228,837	(65%)	(100%)
1966	114,287		255,146		
1967	132,262		394,341		
1968	124,068		251,438		
1969	80,061	99,683	427,841	323,611	423,294
1970	75,849	(24%)	255,172	(76%)	(100%)
1971	86,270		289,447		
1972	99,066		315,783		
1973	98,015		361,091		
1974	85,398	84,997	311,809	290,466	375,463
1975	95,655	(23%)	257,249	(77%)	(100%)
1976	46,849		205,897		

These statistics are subject to periodic marginal adjustment.

It is seen from these revised figures that the movement to grilse as a percentage of the total numerical catch was very great by 1967-1971 in a comparison with the opening quinquennial period 1952-56. The sequence 1962 to 1974 constituted a great grilse cycle not markedly dissimilar to 1812-1849 or 1881-1896. Doubtless the decline of salmon was emphasised by the growth of the Greenland salmon fishery from the early 1960s, since it is known Scottish salmon are caught there. The percentage increase of grilse would be similarly enhanced through the fact that the grilse are known not to travel so far as Greenland.

Table 131 following offers a comparison of the revised and corrected values for grilse with the uncorrected reported catches of Table 129 and also with independently aged samples by scale-reading at three combined net fisheries over 1969-76:-

Table 131

Comparison of Two estimates of Percentage of Grilse in the Annual Catch at Three Net Fisheries

(Source: Department of Agriculture and Fisheries for Scotland.)

Year	Percentage of Grilse in			
	A Reported catch (uncorrected)	B Reported catch as corrected	C Independently aged sample	Difference between B and C
1969	58.9	84.0	80.7	+ 3.3
70	59.6	76.4	72.5	+ 3.9
71	61.3	73.9	74.2	- 0.3
72	50.8	74.9	70.0	+ 4.9
73	50.5	75.5	75.9	- 0.4
74	58.7	79.3	74.5	+ 4.8
75	52.1	67.3	67.2	+ 0.1
76	60.2	69.4	71.3	- 1.9

Whereas, by nature of the Scottish return-migration, the reduction of the salmon catch in Table 130 was reflected numerically mainly by a decline of 2SW fish, the decline of 3SW and older fish is believed to have been proportionately considerably greater. In the Scottish return-migration 3SW and older fish are residual stock: When there are many 2SW fish there is usually a much bigger residual stock of 3SW and older fish than when 1SW fish are dominant in the return-migration. When 1SW fish are as dominant as during 1967-1974 the 2SW stock is comparatively small and the stock older than 2SW reduced numerically almost to negligible proportions.

Two further tables offered provide additional information about the return-migration in Scotland 1952-1976. Table 132 , derived from Table 130, gives a more detailed breakdown of the decline of the salmon catch by season after theoretical adjustment for the grilse error.

(Contd.....)

Table 132

Scottish Net Fisheries Catches, 1952-1976 (As Revised)

(Source: Department of Agriculture and Fisheries for Scotland.)

Year	Spring salmon: Feb to April inclusive and five-year average		Mixed spring and summer salmon: May and five-year average		Summer salmon: June to Sept corrected catches and five-year average		Grilse: corrected catches and five-year average	
1952	86,713		41,506		72,683		145,091	
1953	66,070		35,997		65,625		135,509	
1954	94,737	72,147	37,401	35,112	70,755	78,331	113,063	126,987
1955	66,078		33,088		106,249		131,970	
1956	47,139		27,570		76,342		109,300	
1957	48,074		31,525		75,225		186,978	
1958	44,204		33,782		84,811		192,588	
1959	88,441	51,683	30,686	29,376	103,328	82,427	112,518	165,108
1960	39,186		28,403		80,893		183,431	
1961	38,511		22,482		67,879		150,027	
1962	26,247		22,058		76,831		296,477	
1963	68,160		32,100		82,801		171,900	
1964	36,338	40,679	23,744	22,995	88,035	76,811	326,348	255,742
1965	38,618		18,167		75,036		228,837	
1966	34,030		18,905		61,352		255,146	

1967	26,476		14,372		91,414		394,341	
1968	29,171		13,712		81,185		251,438	
1969	15,764	20,985	10,746	12,393	53,551	66,325	427,841	323,611
1970	18,236		9,499		48,114		255,172	
1971	15,277		13,634		57,359		289,447	
1972	17,412		25,765		55,889		315,783	
1973	23,154		13,995		60,866		361,091	
1974	14,503	19,125	13,396	14,896	57,499	50,975	311,809	290,466
1975	27,994		14,120		53,541		257,749	
1976	12,563		7,205		27,081		205,897	

Table 133 derived from Table 129 gives information on the catches of salmon and grilse by district in Scotland over 1952-1975. These figures are unadjusted for the grilse error. The four districts are: The primary district containing most of the major river systems that extends over the east coast from the Tweed up to the river Ugie, which is located at the entrance to the Moray Firth. The next and secondary district extends over the east and north coasts from the Deveron round to the Naver. The remaining two districts covering respectively the north-west and the west coasts, and the south-west coasts between the stated locations are much less productive by comparison.

(Contd.....)

Table 133

Total Catches of Scottish Salmon and Grilse by Net and Rod 1952-1975 by District (Unrevised for the Grilse Error):-

(Source: Department of Agriculture and Fisheries for Scotland.)

5 Year Averages	East Coast: Tweed-Ugie					Moray Firth and North Coast: Deveron-Naver				
	Salmon	%	Grilse	%	Total	Salmon	%	Grilse	%	Total
1952-56	137,294	72	54,676	28	191,970	68,375	55	56,088	45	124,463
1957-61	131,434	64	73,739	36	205,173	57,288	49	60,596	51	117,884
1962-66	140,923	56	112,556	44	253,479	61,084	47	68,133	53	129,217
1967-71	125,021	45	154,751	55	279,772	47,808	38	78,441	62	126,249
1972-75 (4 year average)	117,287	45	143,774	55	261,061	60,437	43	79,868	57	140,305

Table 133 (Cont'd)

5 Year Averages	West Coast: Hope-Loch Fyne					South West Coast: Ruel-Annan				
	Salmon	%	Grilse	%	Total	Salmon	%	Grilse	%	Total
1952-56	11,688	45	14,215	55	25,903	12,977	63	7,462	37	20,439
1957-61	11,806	37	20,359	63	32,165	17,544	54	14,935	46	32,479
1962-66	15,447	36	27,418	64	42,865	21,816	46	25,650	54	47,466
1967-71	15,830	38	25,982	62	41,812	15,489	40	23,370	60	38,859
1972-75 (4 year average)	20,157	49	21,107	51	41,264	10,864	44	13,709	56	24,573

N.B. The 1952-56 catches may be taken as approximately true figures of salmon and grilse, and the grilse error is at its peak during the 1967-1975 period.

Even without the revision for the grilse error, there are clear indications that the primary Tweed-Ugie section is the one where there is the greatest movement of all sections intercyclically between salmon and grilse. In other words, the many big rivers included in this section are likely to be noted particularly for salmon during a salmon cycle and for grilse during a grilse cycle, whereas in the Deveron-Naver section there is likely to be a continuing better balance as between salmon and grilse during the different cycles. The Ruel-Annan district also indicates, second to the Tweed-Ugie section, a substantial movement intercyclically between salmon and grilse. On the other hand, the percentage movement is not marked in the Hope-Loch Fyne district; it is suggested that the marked increase of salmon as well as grilse over 1962-1975 merely reflects the high numbers of heavy grilse wrongly classed as salmon in a district where the main salmon and grilse runs occur together during the summer months.

Salmon and Grilse Weights 1952-1976

It is known that as the grilse runs increased numerically the average weight of the grilse also increased, particularly from the 1962 season. It is believed that as the salmon run declined the average weight of all age-classes of salmon also may have tended to increase marginally. A more comprehensive answer to questions about weights will be available when the Department of Agriculture and Fisheries for Scotland has completed the analysis of its records 1952-76.

Postcript

Just as this thesis was completed the first 1952-76 record

computer print-outs for three of the major river districts were kindly sent to me by Inspector of Salmon Fisheries Robert Williamson of the Department of Agriculture and Fisheries for Scotland, for me to work on. These are advance copies and may be subject to very marginal adjustment in their final form. Particularly since their contents do not conflict in any fundamental way with earlier records and comment used to depict the general picture over 1952-76 they are added via this postscript.

These print-outs cover three principal produce districts of the Aberdeenshire Dee, Tweed and Tay. They are not adjusted for the grilse error. This means that whereas the total catches of salmon and grilse taken together are correct, or approximately correct, only the spring catches of salmon (2SW and older), January to April inclusive, reflect the true catch by sea-age, since the true catches of summer salmon (2 + SW and older summer fish), May to December, and of grilse, both given separately, are respectively overstated and understated, in proportions varying according to district. It is not reasonably possible at this stage to devise a statistical method to give an approximately true picture of the division between summer salmon and grilse for every district.

The Dee district record is given first, because it is the district in which, having regard to the historically comparative low weights of the grilse in the Dee, there is likely to be the clearest picture of the division between summer salmon and grilse: Table 134.

The computer print-outs have been slightly re-worked in respect of fish weights, to give annual average weights for each class.

The Aberdeenshire Dee District

Table 134
Dee District: Annual Numbers and Weights of Salmon and Grilse Caught by all Methods 1952-76
(Source: Department of Agriculture and Fisheries for Scotland.)

Year	Salmon Jan-Apr. Numbers	Salmon Jan-Apr. Av. Wt. in lb.	Salmon May-Dec. Numbers	Salmon May-Dec. Av. Wt. in lb.	Grilse Numbers	Grilse Av. Wt. in lb.	Total Fish
1952	28,380	9.53	8,737	10.58	10,432	4.14	47,549
53	21,457	9.15	12,194	9.59	9,834	4.50	43,485
54	22,894	9.90	10,780	9.82	5,861	4.73	39,535
55	17,779	9.70	9,412	9.91	8,079	4.62	35,270
56	13,817	9.80	12,338	9.82	8,839	4.34	34,994
57	16,332	9.29	13,126	9.41	12,646	4.47	42,104
58	15,279	10.08	10,896	10.43	12,547	4.68	38,722
59	27,095	9.19	9,822	9.92	5,014	4.42	41,931
1960	19,958	9.54	12,587	10.08	19,937	4.60	52,492
61	13,118	9.31	7,606	9.56	7,785	4.44	28,509
62	10,166	10.18	9,422	10.12	10,914	5.42	30,502
63	29,544	9.52	12,057	10.17	10,337	5.14	51,938
64	14,266	8.91	15,101	9.47	14,449	5.09	43,816
65	12,886	9.98	10,431	10.09	10,490	5.38	33,807
66	10,973	9.83	11,806	10.05	10,437	5.32	33,216
67	6,712	10.31	9,783	10.49	14,670	5.41	31,165
68	8,604	9.27	9,655	10.14	11,446	5.28	29,705
69	4,854	10.15	6,366	10.01	18,719	6.02	29,939
1970	5,141	9.36	5,528	9.88	15,425	5.37	26,094
71	4,638	9.15	5,721	9.75	15,783	5.74	26,142
72	6,548	9.56	7,480	10.38	14,879	6.35	28,907
73	7,828	10.57	8,850	11.28	31,619	6.56	48,297
74	6,153	10.99	7,197	11.73	18,675	6.00	32,025
75	12,527	10.66	6,915	11.05	14,291	6.05	33,733
76	6,451	10.12	4,225	10.26	13,302	5.40	23,978

It is seen that the spring salmon were in continuous decline from the early 1950s until the late 1960s, allowing for the exceptional seasons of 1959 and 1963. From the later 1960s through the 1970s the spring runs stabilised at a comparatively low level. From the middle 1950s there appears to have developed a tendency, noticeable in the Scottish salmon fishery as a whole, for the main salmon run to laten towards the later spring and summer. The grilse increase began promptly, as in the fishery as a whole, in the 1957 season, the grilse cycle peaking in the Dee during 1969 to 1974. The average weight of the grilse increased markedly from the 1962 season, again as in the fishery as a whole.

The Tweed District

Table 135
Tweed District: Annual Numbers and Weights of Salmon and Grilse Caught by all Methods 1952-76
(Source: Department of Agriculture and Fisheries for Scotland.)

Year	Salmon Jan-Apr. Numbers	Salmon Jan-Apr. Av. Wt. in lb.	Salmon May-Dec. Numbers	Salmon May-Dec. Av. Wt. in lb.	Grilse Numbers	Grilse Av. Wt. in lb.	Total Fish
1952	21,192	8.39	11,195	10.96	10,429	4.39	42,816
53	18,703	7.83	11,717	9.60	14,471	5.01	44,891
54	33,895	7.87	17,273	9.56	10,084	5.00	61,253
55	19,434	7.71	18,531	10.34	9,861	4.60	47,826
56	15,526	7.72	15,114	10.10	12,288	4.82	42,928
57	23,968	7.42	15,288	9.12	17,518	5.00	56,774
58	19,374	7.77	16,973	9.60	24,909	4.87	61,256
59	38,670	7.88	20,516	10.55	12,989	5.20	72,175
1960	18,074	7.84	19,387	10.74	33,236	5.37	70,697
61	14,773	7.80	17,066	10.82	25,495	5.13	57,334
62	11,638	8.00	28,380	10.82	52,494	5.80	92,512
63	21,519	8.43	27,677	11.52	16,227	5.42	65,423
64	11,194	7.44	29,996	10.57	28,703	5.24	69,893
65	16,032	7.71	25,285	10.39	28,454	5.64	69,771
66	11,607	8.21	23,972	10.68	35,870	5.55	71,449
67	12,005	7.95	36,805	10.15	49,900	5.79	98,710
68	8,633	7.74	27,097	11.54	27,477	5.49	63,207
69	3,458	8.20	34,702	10.58	64,784	6.01	102,944
1970	9,250	8.50	22,789	10.95	37,111	5.53	69,150
71	6,287	8.16	15,768	10.55	38,290	5.71	60,345
72	5,983	8.37	28,858	11.21	29,691	5.92	64,532
73	4,497	9.23	29,072	11.74	26,101	5.94	59,670
74	2,325	9.33	14,368	11.28	26,215	5.70	42,908
75	5,779	9.65	18,605	11.77	22,571	5.87	46,955
76	3,161	9.08	10,414	10.98	9,338	5.32	22,913

The decline of spring salmon was slower in the Tweed district than in the Dee, not becoming marked until the early 1960s. In fact, the salmon run as a whole remained very strong in Tweed until the early-middle 1960s. As in the Dee, from the middle 1950s a trend developed for the main salmon run and catches to move away from the early spring towards the later spring and summer. The grilse increase started promptly in 1957, and from 1959-60 the average weights of the grilse increased. In the 1962 season there was a great increase in the grilse catch and in their average weight, and also a very marked increase in the late-spring and summer salmon catch as compared to the early-spring catch. It is proposed that 1962 was the first of many subsequent seasons in the Tweed district in which numerous heavy grilse were classed as summer salmon. Paradoxically, this comment does not apply to the next season of 1963, in which there was clearly a good summer salmon run (note the average weight), but from the 1964 season heavy grilse runs predominated, with many of the bigger grilse included in the summer salmon catch. The pattern of the average weights for summer salmon and grilse reflect this combination of factors, including that the residual salmon run was becoming later, therefore with more and heavier late-summer salmon along with many more and heavier (7-10 lb) late-summer grilse. The great grilse period peaked in the Tweed district with the 1969 season. It has often been suggested that U.D.N. and Greenland netting were main contributory factors to the decline of spring salmon in Tweed, but with such a massive head of grilse, i.e. of the smolts returning as grilse, the proposition must seem doubtful.

The Tay District

Table 136
Tay District: Annual Numbers and Weights of Salmon and Grilse Caught by all Methods 1952-76
(Source: Department of Agriculture and Fisheries for Scotland.)

Year	Salmon: Jan-Apr. Numbers	Salmon: Jan-Apr. Av.Wt. in lb.	Salmon: May-Dec. Numbers	Salmon: May-Dec. Av.Wt. in lb.	Grilse Numbers	Grilse Av.Wt. in lb.	Total Fish
1952	7,973	13.91	18,383	15.59	8,449	5.63	34,805
53	5,361	14.30	13,871	14.94	11,456	6.42	30,688
54	7,231	13.30	17,313	14.76	11,066	6.30	35,610
55	5,624	13.57	22,050	14.60	7,386	5.46	35,060
56	4,632	14.24	13,829	14.07	8,611	5.57	27,072
57	4,787	11.55	15,428	12.55	13,911	5.59	34,127
58	4,492	12.43	15,877	13.53	10,765	5.67	31,134
59	6,320	11.84	19,242	13.79	12,281	5.72	37,843
1960	4,412	12.68	22,166	14.17	19,435	5.99	46,013
61	5,165	11.79	16,355	12.75	16,895	5.76	38,415
62	5,043	13.85	26,061	13.12	28,052	6.50	59,156
63	9,525	11.11	29,529	13.41	14,348	6.16	53,402
64	6,325	11.44	30,083	12.47	29,888	6.04	66,296
65	5,955	11.40	23,334	12.43	23,111	6.19	52,400
66	6,073	11.66	31,004	12.42	22,591	6.12	59,668
67	5,687	11.91	36,391	12.07	35,042	6.27	77,120
68	7,031	10.10	35,586	12.46	32,087	6.07	74,704
69	5,795	11.26	49,912	11.77	48,722	6.53	104,429
1970	4,595	10.99	30,704	12.05	35,316	6.18	70,615
71	3,654	10.50	29,569	11.42	33,518	6.33	66,741
72	5,235	11.11	34,490	12.09	27,064	6.55	66,789
73	7,067	12.07	47,255	12.10	34,274	6.59	88,596
74	4,627	12.03	35,605	12.43	31,533	6.36	71,765
75	6,546	11.41	33,484	12.31	23,586	6.55	63,616
76	3,295	11.46	13,433	11.40	12,470	5.94	29,198

A numerical decline of the spring stock is not so positive in the Tay catches as in either the Dee or the Tweed. That does not mean to say that it did not take place, particularly in regard to the winter-running heavy 3SW fish for which the Tay had such a reputation among the angling fraternity. In fact, the rapid decline of the average weights of the spring fish after the early 1950s indicates that this is precisely what happened. The good and continuous run of heavy clean fish that formerly came in from late October or early November steadily decreased from the later 1950s and early 1960s, and the January and February angling on the upper beats below Loch Tay deteriorated remarkably within the decade mid-1950s to mid-1960s. The run of heavy winter fish was progressively replaced in the 1960s by increased runs of small 2SW fish that started to come into the system in numbers from January and February, keeping some of the lower and lower-middle beats reasonably stocked with fresh fish, but denuding the upper beats that had formerly relied on a big head of heavy late-autumn and early-winter running fish to stock them for the opening of the angling in January. After 1968 the run of 2SW itself tended to laten, proportionately more coming in after the middle of March.

The increase of the grilse in the Tay and the gradual reduction of the summer salmon average weights to accommodate the heavier of them was a steadier process than in Tweed, but progressively marked from the 1960 season. In 1962 occurred the usual quantum leap in the average weight of the grilse, the grilse cycle peaking in the 1969 season. From 1964 through to 1975 the late-summer and autumn grilse were of very heavy average weights. In August and September of

the 1973 season the writer spent several weeks fishing some of the best angling beats of the lower Tay, and the catches of heavy grilse, averaging nearly 9 lb each, were enormous. The late-summer salmon (2 + SW) were 15-28 lb.

The Tay had retained throughout the great early-running salmon cycle a substantial run of summer, as well as spring, salmon. This was the main migration of the lower river system and its tributaries, which reproduced and grew there, similarly to the summer run of the lower Ness system.

The Thurso Rod Catches 1951-75

In Table 82 of Section III the river Thurso rod catches by month throughout the season were provided over the period 1922-50. In order to give an example of the effect on the salmon rod fishing of the great grilse cycle, and to contrast this with the spring fish-dominated cycle that lasted until the 1950s or early 1960s, according to river and district, the Thurso rod catches 1951-75 are collated in Table 137.

Table 137

Numbers of Salmon and Grilse Caught by Rod-Fishing in the River Thurso 1951-1976

(Source: Records of the Thurso Estates Company)

Quinquennial Averages	1951-55		1956-60		1961-65		1966-70		1971-75	
	No.	%	No.	%	No.	%	No.	%	No.	%
January	-	-	-	-	-	-	-	-	-	-
February	4	1	2	-	3	-	5	-	2	-
March	55	8	59	7	52	3	30	3	13	1
April	122	18	128	14	133	8	71	7	53	5
May	122	18	122	13	139	8	108	11	66	6
June	89	13	90	10	85	5	62	6	60	6
July	63	9	113	12	245	15	149	15	129	13
August	70	10	198	22	574	34	269	27	252	25
September	131	19	157	18	370	22	260	26	337	33
October (to 5th)	28	4	37	4	70	4	54	5	107	11
	684	100	906	100	1671	100	1008	100	1019	100

It is seen that the salmon run declined proportionately from the early 1950s but absolutely only after the early 1960s. Over the whole period the salmon run and catch gradually became rather later, moving from the middle spring towards the later spring and early summer. A great increase of grilse started during the later 1950s. This enhanced grilse run appears to peak during the early 1960s, but the summers of the later 1960s were dry, thus inhibiting the runs into the river and reducing the catches. The summers of the early

1970s were also inclined to be dry on the whole, but it is nevertheless true that the grilse run tended to laten over the whole period.

Variations by Sea-Age

The overriding purpose of this thesis is to demonstrate that there are cyclical variations by sea-age in the return-migration of Scottish salmon, and to describe the nature and main characteristics of these variations between the late eighteenth century and 1976. This has been done, statistically with supporting comment from authentic and factual historical sources. As stated in the introduction, the statistical method adopted to describe the cycles is the distinction between "grilse" (1 + SW fish) and "salmon" (2SW and older fish). This is also the general method used in the past. The evidence shows that variations in the return-migration by sea-age are general when they occur, though not identical in form from district to district or even river to river within a district. A description of the main cycles since circa 1790 and comment about their duration is provided in the Summary of Conclusions.

As well as variations by sea-age, variations also occur in two other aspects of the return-migration. These are variations in the timing of the return-migration during the season, and variations in the average weights of each age-class of fish.

Variations in Timing

As detailed references as reasonably possible are provided hereinafter but a full reading of the text is essential.

Variations in the seasonal timing of the main migrations of salmon and grilse occur at intervals. These variations particularly affect salmon. On the evidence since c.1790 seasonal patterns of return-migration, once established, tend to endure for a considerable period of time. Such changes are more of a regional characteristic

than changes by sea-age, being particularly conspicuous in, though not restricted to, the rivers of the most productive Scottish east coast region extending from Spey down to Tweed. These patterns and their variations have an important bearing on both the commercial and sporting salmon and grilse fisheries.

The main general grilse run always arrives at some time during the summer months between June and August, substantially within the netting season. The main salmon run of the principal east coast region between Spey and Tweed may vary periodically, at one extreme taking place during the winter-to-early-summer months, and at the other extreme having a heavy concentration of fish running between the later summer and the early winter months. The commercial nets may miss out at either end of the season to the benefit of the rods, though for the rods nothing is of greater value than a strong winter-spring migration that begins before the netting season opens and that runs in large numbers past the nets, once they have commenced operations, during the high water period of the early spring. "Spring" fish are usually ready takers whereas gravid "autumn" fish are often not.

Salmon

In the closing years of the eighteenth century and the early part of the nineteenth the salmon run in the main Spey-Tweed east coast region that contains most of the major river systems was generally spring and summer based. Excluding a small number of special rivers, comparatively few fish appeared to run during the winter months or during the later autumn. Evidence relating to the build-up of the run in a spread of rivers (Table 19) and in more

detail to the Dee (Tables 21, 22 et seq.); the Don (Table 21 et seq.); Tay (p. 63); Tweed (p.65-6), among other rivers, demonstrates this with varying degrees of probability. It seems clear, for example, that the main salmon runs in neither the Aberdeenshire Dee nor the Tweed began as early as they have during the twentieth century. Davy's and Cornish's descriptive summaries of the return-migration at the period (p.77-8) appears to be widely though not invariably true.

At the same period, the rivers of the north-eastern and northern coasts of the second most productive district, extending from the Beauly round to the Naver and Borgie, experienced a salmon run that was rather more restricted in duration and often proportionately rather earlier, extending from the winter or spring through to the early summer. Helmsdale, Brora, Beauly, Shin, were primarily spring and early summer rivers, with the main run from March through to June or July; a few, limited in number, were noted winter rivers, of which the Ness, Thurso and Naver were the leading representatives (Table 19).

Throughout the grilse-dominated period of the third, fourth and fifth decades of the nineteenth century indications are that there were no major changes in the timing of the salmon runs other than what one would customarily associate with a decline of salmon and an increase of grilse, more particularly a movement of the main salmon run towards the summer months, and a decrease of 3SW residual stock (as in the Shin, Table 29, et seq.). In the 1850s the Tweed salmon run was late-spring and summer-based (Table 50), and retrospective descriptive comparisons of the general picture towards the end of the century with the picture as it had been in the 1850s, 1860s and 1870s,

reported to the Elgin Commission in 1900-1902, all indicate a not dissimilar picture (Tay, Forth, Aberdeenshire Dee, Thurso, among others p.127 et seq.) of a spring and summer salmon fishery.

During the latter part of the century the evidence demonstrates that the salmon run of most if not all districts tended to migrate progressively later in the season. This tendency was first reported to the 1870 Enquiry in regard to the Tweed (p.124) and Tables 50-53 monitor the development of the trend in this river until the end of the century. Evidence to the Elgin Commission described the same trend in many other rivers (p.127 et seq.). Even some of the far northern rivers offered indications of enhanced quantities of, by their own standards, late-running salmon (p.135-40) towards the end of the century.

The era of the late-running salmon continued into the new century, as evidenced by the nets' catches in various rivers, where August usually saw the highest monthly catch of salmon (Tables 69-72, 86-88, among others). During the second decade of this century there was a great change. In 1910 the late-summer nets' catches of salmon were still numerically the highest (and by far the heaviest), but by 1921 the salmon run as a whole had become much earlier, and even more so by the opening years of the 1930s (Tables 67-72, 75-81, among others).

During the early years of the century, as in the later years of last century, the autumn months were either the main sporting season with the rod (Tweed, Table 76) or a main sporting season (Aberdeenshire Dee p.254) dependent upon the river. But by 1923 autumn sport was only a shadow of what it had been only a few years

before (Tweed p.224; Spey:ditto), and the main sport by the early 1920s was during the spring months (Tweed p.234; Dee:ditto).

By the 1930s the spring run had become the main general run, though with many salmon in some districts until about the middle of July. This pattern of return-migration continued with no major change until the later 1950s and early 1960s, according to district, when, with a decline of salmon and the inception of a great grilse period, a tendency developed for the residual salmon stock viewed as a whole to revert proportionately more to later spring and summer migrating habits (Table 134).

The earliness of the salmon migration during the period c.1920 to the early 1960s appears to be unique during the two centuries under consideration. Comparing the seasonal migrations of the two great salmon periods c.1790 - c.1817 and c.1921-c.1963 it is seen that all indications are, in the big rivers of the main Spey-Tweed region particularly, that the incidence of the main runs occurred later in the season during 1787-1817 than during 1921-1963 (Tables 19-22, 76-81, among others).

It seems that, in a comparison with periods short of salmon (e.g. 1818-1857; 1886-1920; 1964-76), those periods when salmon are more abundant. (i.e. 1787-1817; 1860-1885; 1921-1963) usually experience earlier-migrating habits in some degree. It is not claimed that all conflicting evidence against such an interpretation is resolved, nor that such a tendency is invariably a characteristic of a strong salmon migration.

Varying seasonal patterns of the salmon (excluding grilse) return-migration in the Dee and the Tweed during the nearly two hundred years period throw some light on the concept of the "early"

and the "late" salmon river as a permanent entity. Taking the Dee as representative of the former category and Tweed of the latter, it is nevertheless seen that both conform to determinist factors moulding the different general salmon cycles. During the mid-1820s, as has been seen, the Dee main run of salmon began during March and April, terminating during July; in Tweed at the same time the main run was reported to have started in April and May, going on until August or September. By the 1890s the Dee run had spread out over the whole season from early spring until autumn, at a time when the main run in Tweed did not begin until July or August. By the 1920s the Dee had already become purely a winter and spring river, when the Tweed run was rapidly becoming earlier but was still spread out over the entire season from early spring to autumn.

Although it seems from the netting catches over 1921-25 (Table 81) that the Dee could hardly become any earlier, as the run was in decline by May, it is interesting to note that early in the 1930s Wood of Cairnton (Dee) fame could say "....I think the fish are gradually coming up earlier" (Scott, Greased Line Fishing for Salmon, 180). By 1930 in the Tweed the main salmon run had become a winter, spring and summer one, being substantially over by the end of July. Winter and spring rod catches in Tweed became considerably greater during the 1930s than they had been during the prolific winters and springs of the 1920s (Table 78). Clearly, however, the Tweed run as a whole was still markedly later in 1930 than the Dee run (Table 79). The fact that during the 'thirties Tweed rod catches of spring fish vied in quantity with those of the Dee (and including nets' catches of both rivers in the comparison Tweed yield of spring fish was greater), while at the same

time Tweed still carried a considerable summer salmon run that the Dee did not possess, is a reflection of the greater fertility and productivity of the Tweed as a salmon river, as well as being a reflection of its inherently different nature.

Grilse

Variations in the seasonal migration patterns of the grilse are much more modest in scope than for salmon, but they do occur.

What information is available about the late eighteenth century and the early part of the nineteenth century grilse runs points quite positively to a July-centred run but with good quantities in both June and August, according to river and district. (Table 20; Salmon Commission, 1825, 132-34).

A comparison of the general picture during c.1850-1910 with c.1911-1950 shows that the main grilse migration became considerably earlier from the first decade of this century at the same time the salmon run became earlier (Table 83, among others).

There are many available descriptions of late-running grilse in the 1880s and the 1890s when grilse were numerous (p.155 et seq.).

In the Tweed it is clear that the grilse run became rather later at broadly the same period the salmon run became later (Tables 53,54). Indications are that other major rivers may have shared a similar experience in some degree between the middle and the late parts of last century (Tay: p.128).

It is also known that the grilse-dominated decades of the 1960s and 1970s experienced later grilse runs generally than occurred during 1911-50.

Conclusions are tentative but worth drawing. First, when the

salmon run latens the grilse run usually tends to laten, e.g. c.1870-1910; 1960-76; and when the salmon run becomes earlier the grilse run become earlier c.1911-50. And vice-versa, without comment on the nature of possible interdependence. Second, when grilse are numerous the migration tends to laten or to extend over a longer period of the season, or both.

Variation by Weight

1790-1849

All the evidence available from specific rivers tends to validate Hogarth's general description of low average salmon weights in the early nineteenth century, or at least low average 2SW salmon weights (p.83). Average salmon weights were low then throughout the season, unprecedentedly so by latter-day standards (Tables 26, 27, 28). Grilse weights also were low (Tables 26, 27, 28), though not without more recent comparison (e.g. the Dee of the 1920s, Tables 103-112).

The only specific reference to salmon weights in the biggest class of river informed that the most common salmon weight in the Tay was "12 to 14 lb", which would indicate the dominant class as 2 + SW summer fish (p.64).

There are clear indications from these weights of both a low 2SW stock average weight, and comparatively few 3SW fish from the 1820s contemporary with the peak of the grilse cycle being reached.

The low weights of salmon and grilse in Dee and Don in the 1823 and 1824 seasons relate to this period when the salmon run was in sharp decline and the grilse run proportionately increasing. Ewe weights of 1808, also low, related to a salmon dominant period.

Evidence from the Shin points to a great decline of the large spring migration of 3SW fish during the grilse cycle (p. 84) as compared to the salmon cycle (Table 29), the residual stock of salmon by the 1830s being largely of 2SW age. This emulates the known similar experience of many rivers during the grilse cycle of the 1960s and 1970s, that were noted during the previous salmon cycle for 3SW early-running fish.

On the other hand the average weights of the salmon from several coastal districts of the Dee, Don and North Esk districts, and further north, over 1837-1850 (Table 58) demonstrates, as compared to 1824, higher average weights, which may point to a latening of the main salmon run to the later spring and the summer months during the grilse cycle; (as tended to occur also during the grilse cycles of 1881-96 and 1862-76). Grilse average weights from the same nets (Table 58) are also somewhat higher than for early part of the century in Dee and Don. Overall, these average weights are not particularly heavy for a grilse dominated cycle, as compared either to 1962-1976 or to general indications for 1881-1896.

1850-1900

The general picture for the whole of the century from its early years up to 1860 is of initially low average weights for 1SW fish up to the 1820s, increasing thereafter but still seemingly rather low for a grilse-dominated cycle. The 2SW weights were low until the 1820s, seemingly increasing from the 1830s through to the later 1850s. Evidence from the 1850s indicates a continuing modest average grilse weight and a reasonable salmon weight (Tables 58, 59, p.146).

From the late 1850s the general picture changed. Examples from

many sources point to increased stocks of heavier salmon in those rivers noted for such classes of fish e.g. Tweed: 2 + SW (p.116); Tay and Forth 2 + SW, 3SW and 3 + SW (p.116); Billingsgate returns, Table 34, among others. An increased salmon run would not necessarily yield heavier average salmon weights in a river such as the Dee, where the increase would normally be reflected by larger quantities of earlier-running small 2SW fish (Table 59; Maxwell's comments p.133).

During the closing decades of the century the salmon run gradually became later and the average weights heavier (Section II, chapters 5,7).

By the 1870s the grilse also were generally of heavier average weights. During the grilse cycle of 1881-1896 the grilse weights were high with quantities of heavy autumn-running grilse (Section II, chapter 7).

1901-1950

Heavy late-summer-running fish declined rapidly during the second decade, to be replaced by increased quantities of early running 2SW fish and, to a much lesser degree, of 3SW big spring fish. By 1915-20 the grilse had considerably declined in average weight as compared with the early 1890s, and the grilse run as a whole had become considerably earlier than at the turn of the century. Comments on weights over this period are restricted to a limited number of major rivers for which some weights analysis is available.

Spey

It is seen that there was by the 1920s a fundamental difference in the structure of the salmon run as compared to 1901-1903 (Tables 91-99). During 1901-03 the early spring fish were of comparatively low average weights, apparently with few 3SW fish, but with many and rapidly-growing summer fish. By the 1920s the

spring and early-summer fish were increased in average weight, with considerable quantities of 3SW fish, but with considerably reduced average weights for the later-summer fish.

There was no marked variation in the grilse weights.

A. Dee

The salmon run by the beginning of the 1920s had become very early (Table 81), in a comparison with the 1890s (Tables 62, 63), and earlier periods. 2SW spring fish were the dominant class of salmon, and the average weight was therefore low (Tables 103-114).

Grilse weights were very low in the early 1920s, and the grilse run early in a comparison with the 1890s (Tables 103-114, 62-63). The lack of incremental growth of the grilse during the summer months is clear in some years.

Tweed

Notwithstanding the steady increase of early-running stock during the second and third decades of the century, Tweed until the 1930 season retained its traditional structure of small 2SW spring fish but rapidly growing 2 + SW summer fish, with few 3SW spring fish, some years after that structure had disappeared in the Spey (and most other east-coast rivers). In the 1930 season the average weights of the 2 + SW salmon declined as the late run decreased. (Tables 116, 117).

The grilse run had declined to a very low level by the later 1920s, but improved as elsewhere from 1930. The grilse were of heavier average weights than in Dee or Spey (Tables 116, 117).

Forth

There appears from a modest sample to be a marked reduction of average weights in the summer salmon of the Forth during 1920-1922 as compared with 1901-1903 (Table 123). In 1921 can be seen the lack of incremental growth of the grilse that is clear at the same period in other rivers (Table 124).

Tay

Probably owing to the sharp division between the upper and lower river systems in this watershed, the lower being tenanted by indigenous late-running stock, there is a marked difference between this and the other major rivers considered. The winter and early spring run of the Tay was substantially of 3SW fish, many of which may have migrated by the 1930s in most seasons before the netting commenced (Table 121). All classes of fish weighed comparatively heavy in the Tay (Tables 119, 121).

In summary, over the particularly formative second and third decades of the 1901-1950 period, a decline of late-summer salmon was accompanied by a marked tendency for their average weights to decline, although this was not obvious by the early 1920s in the Dee. The increase of the spring run was reflected by bigger average weights of the early fish, except in the Tweed, a substantial contribution to this being made by increased quantities of 3SW fish.

Grilse weights generally were low by historical standards, though varying. As with the salmon, there was a noticeable lack of incremental growth during the grilse migration of some seasons by the 1920s.

1951-76

From the 1957 season, but particularly from the 1962 season, the grilse greatly increased in quantity (Table 130). In and from the 1962 season the average weight of the grilse increased (Tables 134-6). The Department of Agriculture and Fisheries for Scotland is preparing a paper that will demonstrate this development and its properties during 1962-76.

From the later 1950s and early 1960s, according to river, the salmon run declined, to stabilise during 1969-76 at a low level compared with 1952-56 (Table 130). There are indications from many rivers that the residual stock of both 2SW and 3SW have increased in average weight from the early 1960s and particularly over 1969-76. When the Department will publish a detailed analysis to provide a proof is not yet known, but probably during 1982.

Quite clearly there is a tendency over the 200 years under consideration for grilse to be of comparatively heavy average weight whenever they are numerous, but this may not amount to an invariable rule, and certainly does not do so on a year-to-year basis, as is seen from the great grilse period of 1881-1896. During this period many years of heavy grilse runs did enjoy a conspicuously increased average weight as compared to long-term grilse weights, but a number of big grilse seasons over the sixteen-year period experienced moderate average weights, in some runs at least. On the other hand, increased average grilse weights seemed to be more general over the period 1962-74, and particularly over 1969-74. Different grilse cycles may possess in some degree their own characteristics.

It is much more difficult to read any pattern into the salmon

weights, at least those available in the thesis.

Since the start of the period under discussion there have been several discernable periods when the 2SW fish have followed different seasonal running patterns with different average weights assessed on a monthly basis. Early in the nineteenth century the average weights from most of the limited number of rivers isolated with relevant information were comparatively low, notwithstanding that the main runs, in the southern rivers particularly, were during the later spring and summer. Late in the century the average weights were comparatively high, associated with many late-summer fish. For much of the twentieth century there were heavy spring and early summer runs of relatively high average fish weights in many rivers in relation to their season of migration. During the 1970s the 2SW fish are known to have been particularly heavy in relation to their time of migration in many rivers.

Early in the nineteenth century all classes of 2SW fish were of low average weight, whether in spring or summer. Late in the century the average weights of the spring fish appeared to be in no way exceptional, but the numerous summer salmon increased in average weight rapidly by incremental month. During much of the twentieth century from c.1920 to c.1960 the 2SW spring fish were of comparatively high average weights and also the early summer salmon of many rivers, but in the later summer the few 2 + SW fish running failed to put on rapid incremental weight in the pattern of the later nineteenth century, as also did the grilse in many seasons.

Inadequate information is available to take the discussion any farther, and to link the weights of the 2SW fish with the weights of

the 1SW fish directly by a determinist statistical hypothesis. It may not be impossible with much more information to establish a link - but a trend analysis rather than anything rigorously determinist, and, moreover, one that has to take into consideration lapses of years between changes in the salmon weights and changes in the grilse weights at broadly the same periods. At one extreme, the numerical decline of the grilse and their corresponding decline of average weights after 1895 was only slowly followed by a change in the nature and weights of the salmon run from the early years of the present century, and not until the season of 1921 did the new salmon cycle associated with small quantities of grilse of low average weights become clearly established. On the other hand, the changes in the grilse and the salmon average weights occurred simultaneously during 1857-1862 at a time of changing cycles (Tables 58 and 59; Tweed documentation, and etc.).

Factors Influencing the Return Migration

It is necessary and interesting to discuss what light the thesis may throw on the factors influencing the return migration. The whole subject of the influence respectively of genetical and environmental factors on the return migration by sea-age and the season of return, and their respective contributions, is still speculative and controversial. This thesis is a contribution to the pool of knowledge but it cannot by itself provide a full explanation of the causality of the return migration because it has not been its main purpose to adduce evidence about the possible factors involved. Therefore it is helpful to state briefly what the main environmental and genetical factors involved actually are or are believed to be,

and then to consider what bearing the information given here may have on them. M.L.G. Gardner has given a detailed and closely-argued review of factors which may influence the sea-age and maturation of Atlantic salmon (J. Fish Biol. 1976 9.289-327).

Genetical and Environmental Theories

Piggins' research (1969, 1974) on Atlantic salmon in Ireland provides clear evidence that there is a genetic element in determining if the progeny will return as grilse or as older fish. Elson's research (1973) on Atlantic salmon in Canada provides clear evidence of a genetic influence on the duration of sea-absence. The research of Rich and Holmes (1928) into Pacific Chinook salmon led to the conclusion that heredity rather than environmental factors determined the time of year at which the adult chinook returned to fresh water. Richter (1972) concluded that genetic factors play a major part in the determination of age of maturity and of the season of return to fresh water of adult chinook, sockeye, pink and Coho Pacific salmon.

Notwithstanding this clear genetical evidence, environmental influences appear to be strong. If sea-age were an inherited trait without being influenced by other factors, grilse would breed grilse and salmon would breed salmon. Piggins in Ireland released tagged salmon smolts which had been hatchery-reared from spring salmon parentage. In one case 85% of the tagged individuals recovered as adults were grilse, and therefore had not adopted the sea-absence habit of their parents. The collective result of 13 years of releasing smolts showed the majority of returning adults were grilse regardless of parentage. Hence, although there was a genetic

influence on the time of return to fresh water, environmental factors of unknown nature appeared to have a greater influence.

White (1936) and White and Huntsman (1938) reported on the transplantation of fry hatched from ova of Restigouche River Atlantic salmon, which normally entered their home river in spring as 2 and 3SW fish, into an apparently barren branch of the Apple River, Nova Scotia. These transplanted fish migrated as two year smolts and were marked. Their age at smoltification was characteristic of Apple River fish rather than Restigouche smolts which migrate at three years old. Of the marked adults which were recaptured, 95% were grilse and 5% were 2SW fish. Thus these progeny of the Restigouche spring salmon substantially adopted the sea-absence habits of the salmon of their new environment.

It therefore seems clear that both genetic and environmental factors influence the nature of the return-migration, but that the comparative extent of this influence is uncertain.

It is really necessary to point out that the fishery at which Piggins conducted his research is a typical small Irish west coast system where grilse at all times form the dominant proportion of the stock. Between 1960 and 1970 there was a very marked decline of 2SW and older fish contemporary with a substantial increase of grilse in the Irish salmon fishery as a whole and this was to some extent reflected in Piggins' own fishery. It is likely that this change by sea-age in the return migration influenced the results obtained by Piggins in his research. The line-breeding carried out by Piggins may also have warped in a different way the comparison of events in his fishery with events in the wild salmon return-

migration in Ireland, and indeed the British Isles as a whole.

The research of Rich and Holmes was undertaken during the period 1916-1927 at a time when rapid changes by sea-age in the Scottish return-migration were taking place and the main salmon run (excluding grilse) was becoming much earlier. It is not known whether the same or similar events were being experienced in the Canadian Atlantic or Pacific salmon rivers at the same time, but it is known that the decline of 2SW and older fish and the increase of grilse experienced in the 1960s in the Scottish fishery were also observed in the Canadian Atlantic salmon fishery or parts of it. It is therefore possible that Rich and Holmes were working at a period of change that renders suspect any comparison of events at that time with subsequent and particularly with recent events.

The work of White and White and Huntsman in the 1930s may also be suspect in a comparison with events in other periods. It is possible that the minority return of 2SW fish in what may be essentially a grilse fishery (the Apple River) resulted from changes in the salmon return-migration by sea-age common to all or many countries in the northern hemisphere at the period, when the decline of grilse and increase of older salmon throughout the British Isles was most marked.

Similar comments about both sea-age and season of return may also apply to Elson's research.

If all or any of these comments are valid the significance of the results obtained becomes more doubtful.

More Detailed Comments on the Genetic Theory

Some theoretical examples can be stated to demonstrate the

genetic theory and its possibilities in relation to the Atlantic salmon in Scotland. By way of introduction it is constructive to state some properties of the salmon migration generally believed to be true that offer a basis to this discussion.

Although a few salmon stray it is generally accepted that the great majority of salmon home to their natal river. Therefore each river has its own salmon stock separate from the stocks of all other river systems. This has recently been shown by Piggins' group who compared some biochemical properties of salmon from various rivers in Ireland, Norway and Canada. It is also widely accepted that there can be separate breeding populations within each river stock (more about this complex subject subsequently). In Scotland the main smolt migration in all rivers takes place or is believed to take place in the spring, followed in some rivers at least by another lesser migration in the autumn. Therefore it seems there is a smolt migration pattern common to the Scottish salmon fishery as a whole regardless of the sea-age of parents or the smolts' sea-age of return, even where the comparative rate of parr growth between rivers influences variously the age of the smolts at migration.

It now seems possible that many Scottish salmon following migration as smolts spend their first summer feeding on the continental shelf in the vicinity of the Faroes. If this is so, there would be no difference in habit between different river stocks or demes (i.e. breeding groups within a river stock) at this stage. At the end of their first winter, the fish feeding around the

Faroes appear to split into two basic groups: the first group stays at the Faroes, continues feeding during the spring and early summer and migrates into the Scottish rivers during the summer months. These are grilse (1 + SW). The second group of fish probably leave the vicinity of the Faroes and may move to new feeding grounds off Greenland and subsequently return to fresh water after spending one or more winters there. These are the salmon of 2SW, 2 + SW, 3SW, 3 + SW and etc.

The vital stage of the matter is now reached. The difference between the first and the second groups of fish could be either genetical (inherited) or environmental. Grilse could be the offspring of grilse and capable only of behaving like grilse and spawning further grilse, or grilse could be those fish that have either grown less well or grown faster by the end of the first winter, and because they are smaller or bigger fish than the average are "switched" into behaving like grilse and returning to spawn during the following summer instead of moving on to Greenland, whereas the larger or smaller fish proceed to Greenland and spend at least one more summer feeding in the sea before returning to their Scottish rivers.

The basis of the genetical theory is that the two groups differ in their genetical (chromosomal) make-up so that within each river system there are separate demes that are grilse and the various ages of salmon. In the most extreme and rigid genetical theory each of the age groups would differ genetically because heredity would be the overriding main determinant of both age of return from the sea and season of return from the sea.

If this genetical theory is correct, the observed cyclical variations by sea-age must be the result of changes of numbers within demes. An increase of grilse must result from better survival or greater numbers produced of grilse demes, and this could happen entirely independently of what happens to the various salmon demes. Each of the salmon demes would also vary independently of the grilse and of all other salmon demes. All this supposes no interbreeding of the demes.

The thesis demonstrate that when grilse increase salmon decline; i.e. when the numbers of young salmon increase in the return-migration older salmon decline immediately or subsequently in numbers. Conversely, at periods when the salmon (older fish) increase in numbers, grilse (young fish) decline in numbers. This relationship often cannot be seen on a short-term year-to-year basis, but it can be clearly observed over a period of several years. During short periods of up to a few continuous years there may be heavy joint runs of salmon and grilse in the fishery as a whole, but such phases have in the past led to a decline of old fish and an increase of young fish, (e.g. 1812-1817; 1881-1885; 1957-1966). This delay supports the genetical theory, in that the grilse demes start to become more successful while salmon demes are still having success, and that a few years later the salmon demes become less successful but the grilse demes continue to be successful. This may be a more rational interpretation than to believe that the same breeding stock is changing in habit from salmon to grilse.

There are periods when a majority of the smolts that

eventually return do so as grilse, and conversely there are periods when a majority of the smolts that return do so as salmon. As described elsewhere in the Discussion, the evidence appears to demonstrate that in the Scottish fishery viewed as a whole the large 3SW (and older) fish are residual stock: i.e. when 1SW fish are dominant in the return migration, the number of 2SW fish will be comparatively small during the peak period of the grilse cycle, and the 3SW fish will be reduced to a tiny proportion of the total numerical return migration; whereas at periods when grilse decline and 2SW fish increase and become numerically dominant in the return migration the residual stock of 3SW and older fish is considerably increased. If this interpretation of the evidence is correct it seems that the 3SW fish are not a separate stock but are the survivors or delayed spawners of other stocks that return as 2SW fish. Hence heredity is not the single main determinant of age of return for older fish than 2SW.

A modified genetic theory is possible: Inherited differences could be in the season of return from the sea rather than by age measured in sea winters, while the age of return could be affected by the growth made and hence by environmental factors that affect growth. If this were so there would be two basic genetic groups: late-running demes (1 + SW, 2 + SW, 3 + SW and etc. fish) and early-running demes (2SW, 3SW and etc. fish). Then the following scenario would be possible. Since the thesis demonstrates that when grilse are numerous they usually tend to be of a heavier average weight than when grilse are comparatively few (though not always to the same degree in every grilse cycle) this fact is used

as a basic premise in the argument:

1. If feeding around the Faroes is good many fish would be large at the end of the first winter, these fish would mature sexually at a young age, and they (if from late-running demes) would return as grilse, whereas a year later there would be comparatively few 2 + SW fish and the next year very few 3 + SW fish. With poor feeding, few fish would stay at the Faroes but would go to Greenland and there would be few grilse but many 2 + SW fish a year later and a good number of 3 + SW fish the year after that.

For early-running demes the theoretical position is more complex , since evidence seems to indicate that all or most 2SW and older fish probably go to Greenland or other distant waters anyway. The position might be that there would be many 2SW fish and a good residual stock of 3SW fish when feeding is rich, but few 2SW and 3SW fish when feeding is poor. Alternatively there might, theoretically at least, be many 2SW fish and few 3SW fish.

OR

2. If large numbers of smolts are produced, or survive, from late-running demes, then they would theoretically have to share the food at the Faroes with more individuals so average growth would be poor and there would be fewer grilse that year, and consequently more 2 + SW fish next year and also 3 + SW fish the following year. With low survival of smolts from late-running demes, then there would be good rates of growth at the Faroes and there would be many grilse and fewer 2 + SW and 3 + SW fish of the same year-class of smolts.

For early-running demes, again assuming all or most of these

fish go to distant waters anyway, a large quantity of smolts would probably yield many 2SW and proportionately many 3SW fish, assuming good feeding. If poor feeding, then few 2SW and 3SW fish.

But the relative balance between early - and late-running demes must affect events in the sea and it is obviously extremely difficult to argue what would happen with varying proportions of each, particularly as regards early-running demes.

There seems to be some support, by analogy, for these possible scenarios, or something similar to them, from Elson's research (1973) on the Canadian River Northwest Miramichi, where the Atlantic salmon are of distinct early - and late-running summer demes, both 1 + SW and 2 + SW. The grilse and 2 + SW salmon both enter the river in two distinct runs, the early-summer run being before mid-July and the late run after 1st September. The experiment showed clear evidence of inheritance of the duration of sea-absence.

A consideration of the different breeding populations of salmon in some of the bigger Scottish rivers is useful in reconciling the theoretical assumptions.

A highly complex river system such as the Tay has long been noted for widely differing runs by age-class and seasonal return into its numerous tributaries and sub-systems. The main outline is clear enough. For the purpose of this discussion possible effects, if any, of recent hydro-electrification works are ignored. The upper Tay and upper Tummel systems have always been noted for their early-running 3SW and 2SW fish, but few 1 + SW fish; the Lyon for runs of 3SW, 2SW and 1 + SW fish; the Garry for its 2SW and 1 + SW fish but not markedly for 3SW fish; the lower largely "summer fish"

river system, including the tributaries Braan, Isla and Almond, with its big spawning stocks of summer - and autumn-running 1 + SW, 2 + SW and 3 + SW fish, not all these age-classes being proportionately represented in every tributary or in the main river. The tributary Ericht of the Isla has a spring run of 2SW fish as well as a summer run of 1 + SW and 2 + SW fish, but the upper Isla proper is essentially a summer and autumn 1 + SW and 2 + SW fish environment. The Almond at the head of the tide is essentially a grilse river, or has been over the past 25 years or so. The detail is virtually endless because of the extreme and unusual complexity of the Tay, but this general outline certainly covers the main sub-systems. It is clear that the early-running demes largely belong to the upper river and its tributaries and the late-running demes to the lower river and its tributaries.

It is also clear that these Tay sub-systems contain their own breeding populations of salmon and that, for example, a fish born and bred in the Garry will, on entry into the freshwater of the Tay from the sea, head for the Garry to reproduce its kind in the locality and environment where it was born. But are the Tay sub-system runs of fish immutable by sea-age and by season of return? On the contrary, the cyclical changes by sea-age and by season of return that take place in the Scottish salmon fishery as a whole are very marked in the Tay, and also incorporate the concept of asymmetry in the return migration, of which more will be said under a separate heading later in the Discussion.

During the great salmon cycle of the earlier part of the century there were many 3SW winter - and some 2 SW spring-running

fish into the upper Tay and upper Tummel systems; many 3SW and 2SW winter and spring fish into the Lyon, with a modest run of grilse to follow; many spring - and early summer-running 2SW fish into the Garry, with a modest run of grilse to follow; good numbers of 2 + SW summer fish plus some grilse into the lower Tay system proper, not unlike the general pattern in the markedly similar systems of the lower Ness and the Awe at the period (but unlike the Scottish salmon fishery as a whole at the period), because the Tay, as with the Ness - Garry and the Awe - Orchy systems, enjoys (or at least did before hydro-electrification of all these watersheds) a marked and enduring division into upper and lower river systems separated by large lochs.

But at periods characterised by a completely different pattern of return-migration in the Scottish salmon fishery, such as the terminal decades of the 19th century, or the 1960s and 1970s, the return migration throughout the Tay and its principal sub-systems was very different from that prevailing over 1920-1950s. The early-running 3SW and 2SW stocks of the upper Tay and upper Tummel systems were much reduced, being replaced by - apparently nothing, i.e. this deme was much reduced. What exactly happened in the Lyon and the Garry late last century is unknown, but from the later 1950s through to the 1970s the early-running salmon of both the Lyon and the Garry declined but the grilse stock of these two rivers increased. During the two periods there were much bigger stocks of grilse in the lower river as a whole than during 1920-1950s, plus considerable quantities of late-running 2 + SW with a few 3 + SW salmon, i.e. the late-running demes were increased. (In the 1960s and 1970s there were probably more grilse and fewer late-running salmon than during the

late 19th century in the Tay lower system, but that is a comparatively minor element within the general comparison).

It is therefore seen that there have been significant variations of breeding population throughout the complex Tay system both in number and by sea-age from period to period, and this seems to support the genetical theory.

The periodic general cyclical changes in the Tay by sea-age and by season of return do not conflict with the periodic general cyclical changes in the main east coast districts as a whole - indeed they are quite clearly complementary in outline - but because the Tay is such a vast web of sub-systems all the discrete migrations from entry of the fish into the river at the mouth to their true homes are difficult to follow.

In this respect it is much easier to trace the return migration in the Aberdeenshire Dee for two principal reasons: first, the Dee has no major tributaries or sub-systems throughout its course if the small Feugh grilse tributary of the lower river is excluded; and second, it is, unlike the Tay, much more characteristically a young fish river of grilse and 2SW salmon with well-defined migrations. A study of the Dee is particularly useful in bringing out the periodic variations in locality that mark the breeding intensity of the population of 2SW fish as a whole, and in this respect the habits of the Dee 2SW stock are much more typical of cyclical events in the generality of east coast rivers, both big and small, than is the Tay.

Late last century when the Scottish east coast salmon (excluding grilse) in the principal Ness-Tweed district were biased as a whole to summer - and autumn-migration, the Dee, being traditionally an

early river, had a 2SW run that was spread out over the whole season from spring through to autumn (Table 62). At that time the salmon stock spawned throughout the length of the river, the early-running 2SW fish in the upper-river streams and the late-summer and autumn 2 + SW fish in the lower reaches of the river (largely the first 30 miles upstream of the tide). During the early-running salmon cycle of this century, on the other hand, the Dee 2SW run as a whole became much earlier, the main run being a continuous winter and spring one, from December through to May (Table 81). Because this main 2SW fish migration was so early-running it traversed in substantial part the complete river to the upper-reaches while largely ungravid and at spawning time the upper river and its small tributary streams were full of breeding fish. But the spawning reaches of the lower river, formerly occupied by the late-running 2 + SW salmon, were largely untenanted. There is a pool on the lower main Aberdeenshire Dee now called the "Rose Pot", which is a corruption of "Roe Spot", its former name, where the big autumn salmon used to spawn when the Dee had a large true autumn run of 2 + SW fish. From the first and second decades of this century this run rapidly declined, so that by the 1920s there were few autumn-run spawning fish in the lower main river. Hence the name of the pool lost its true meaning and became corrupted.

Thus there are very considerable and marked variations between the early - and late-running salmon demes in the Dee from period to period, and these variations accord well with the general genetical theory.

There have also been great changes in the salmon stock

(excluding grilse), which consists very substantially of 2SW and 2 + SW fish, of the Tweed. Throughout the 19th century, the main numerical migration of the Tweed salmon consisted overwhelmingly of summer fish (i.e. with some sea growth that year) from April or May into the autumn months and even later. There were comparatively few "spring" fish (i.e. with no sea growth that year), and proportionate to the total numerical run of 2SW fish, few fish at all until about mid-April. Then from c.1920 to the early 1960s there were abundant non-gravid 2SW "spring" fish running between December and early May, but much reduced numbers of 2 + SW summer fish, the main run of all 2SW fish being over by the end of July (at least after 1930). Nevertheless, there were proportionately considerably more summer salmon than in the Dee over this period, but most of the 2 + SW fish were themselves earlier running than during the later 19th and early 20th centuries. There was also, as indicated by the angling returns, still a distinct (if modest compared with what it had been) autumn run of big 2 + SW fish in the Tweed, throughout 1930-1960, that came into the river largely in October and November. A possible explanation is that there is more than one deme of summer salmon in the Tweed (and in some other rivers), varying according to environmental influences.

It seems probable that the continuing presence of summer salmon runs in significant numbers during May to December in the Tweed during the great early-running salmon cycle reflects the strong tendency historically for the summer salmon demes in the Tweed to be the dominant strains, and that the early-running deme became dominant for a relatively short period under the influence of extreme environmental influences (later to be argued as climatic) over c.1920s - early 1960s.

This would explain why the Tweed salmon runs at this period were not so well synchronized as in some other rivers. In other words, the Tweed probably possesses salmon stocks of great genetic diversity and the selective forces can result at different times in extremes that may resemble the separate stocks of other rivers. When selective forces are evenly balanced, as seems to have been the case in the Tweed for a period in the 1920s, the whole range of variations may be displayed. For a few years in the 1920s up to 1929 there appears from the combined net and rod returns to have been good spring, summer and autumn salmon runs (excluding grilse).

The evidence demonstrates that different reaches and tributaries of various river systems carry varying spawning populations from period to period relating to the varying patterns of return-migration by sea-age, both of salmon and grilse. Distinct local breeding populations, and therefore reproductive isolation, within river systems do exist, and vary substantially both by quantity and by sea-age over lengthy intervals of time, and such local variations are associated with general variations in the return migration taking place contemporaneously. Numerical variations by sea-age can also occur within the same reaches and tributaries of river systems. This is seen clearly in various sub-systems of the Tay, e.g. the Garry, the Lyon, the lower main river and some of its tributaries, where salmon and grilse numbers may vary considerably in relation to each other from period to period. To what degree the various classes of fish tend to spawn in common localities, and whether or not there may be significant inter-spawning periodically, it is difficult to say, because of the lengthy time-scales involved. In a manner without

comparison in Scotland the return migration by sea-age in the River Wye of England and Wales has been closely analysed for over 70 years, thanks in the first place to Hutton and thereafter to detailed annual reports. Over the 50 years 1910-1960 the grilse stock of the Wye was extremely small, amounting to some 3% by number of the total rods and nets combined catches during 1910-39. /Throughout this period the spawning stocks of the principal spawning tributaries of the Wye system, the Ithon, the Irfon, the Lugg and the Upper Wye proper, were very substantially of 2SW and 3SW fish. In many seasons of the 1970s the spawning stocks of all these tributaries contained substantial quantities of grilse that during 1910-1960 did not exist. Of course, this is not evidence that the grilse spawned with or were descendants of the older salmon.

At this stage it is appropriate to consider the possible causes of the great variations by sea-age and by season of return in the Scottish salmon return migration. Since there appears to be no evidence that they are the result of genetical changes, environmental causes have to be considered. This thesis has demonstrated that changes in the return-migration by sea-age have typically occurred in the major salmon districts of Scotland at broadly the same time. Throughout the principal districts when 1 + SW fish increase greatly in quantity the quantities of older fish decline at once or within the next few years, and vice versa. Such changes were marked, for example, over 1817-1825 and 1960-69 when grilse increased and older salmon declined; and over 1850-1864 and 1897-1921 when grilse declined and salmon increased. When the salmon run increases it tends to become earlier with greater quantities of 3SW and older fish. If these common changes by sea-age and by season of return occur at

broadly the same time in many rivers, it seems most probable that a common factor or some common factors must be the cause. Furthermore, the changes that have taken place in Scotland over the past century are known to have taken place in many other Atlantic salmon countries, at least in some degree. All this evidence tends prima facie to support environmental changes that take place periodically in the northern hemisphere as the main factors causing cyclical variations by sea-age and by season of return for salmon of similar sea-age. This conclusion is perhaps reinforced by the fact that there is a definite tendency for the grilse to increase in average weight, in Scotland at least, at periods when grilse are particularly numerous, if not always to the same extent.

A lead is identified by consideration of the northern hemisphere climate and its variations. Changes in the return migration take place at the same times as significant changes in the climate of the northern hemisphere. In brief, the northern hemisphere was comparatively cold during the seventeenth and eighteenth centuries, the period known as the "Little Ice Age" by climatologists. There are many historical indications that these centuries were dominated by grilse and by summer-running salmon, early-running salmon being few. According to the Greenland Camp Century Ice Core Analysis, between 1780 and 1800 the northern hemisphere became warmer than it had been since the first quarter of the twelth century. (Variations in northern hemisphere climate are much more marked in the arctic and sub-arctic regions frequented by Atlantic salmon than they are nearer the tropics.) This period was contemporary with the great salmon cycle of c.1790-1817, when the salmon run as a whole

(excluding grilse) appears from the limited evidence to have become earlier-running particularly in traditionally early rivers. During the second decade of the 19th century the northern climate became cooler once again, and 1820-1850 reverted to the climate of the previous two centuries. The broad periods of warming and cooling and their associated cycles over the past 200 years are as follows:

Warmer period c. 1780-1817		-	Salmon
Cooler period c. 1818-1850		-	Grilse
Warmer period c. 1851-1880		-	Salmon
Cooler period c. 1881-1900		-	Grilse
Warmer period c. 1920-1950		-	Salmon
Cooler period 1960s and 1970s		-	Grilse
? Warmer period	Late 1970s Beginning 1980s	-	Movement towards Salmon

These dates are, of course, approximate as regards the climatic changes and their related runs by sea-age. It seems from the experience of this 200 year period that the warmer the northern hemisphere becomes, the more numerous and earlier-running the salmon. This is a general comment, and experience in various rivers and districts may show limited deviations. During the climatic "little optimum" of c.1920-1950, when the northern climate was the warmest it had been for about a thousand years, Scottish salmon runs were earlier than ever before recorded.

The Budyko-Vinnikov mean air temperature curve for the north polar belt (72.5N to 87.5N) demonstrates the warming that occurred over 1920-1950, contemporaneous with large runs of spring salmon. The temperature band indicated is highly significant in environmental terms.

BUDYKO-VINNIKOV CURVE

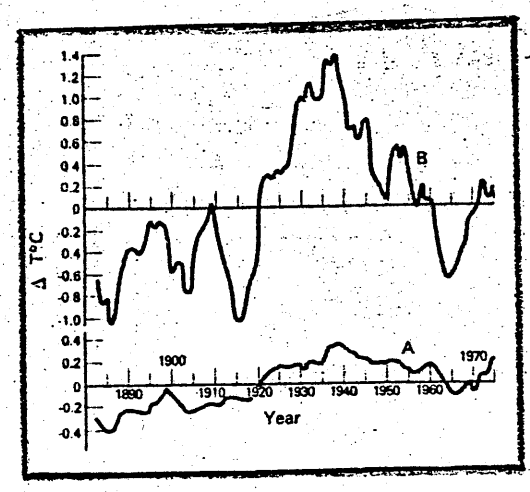


Fig. 1. The trend of mean annual air temperature over the northern hemisphere. The upper curve shows the deviation in degress Celsius from the long-term mean of the north polar belt (72.5N to 87.5N). The lower curve shows the corresponding variation over the entire belt from 17.5N to 87.5N.

The logic of this hypothesis applied to the salmon sea-feeding grounds is as follows: When northern sea-temperatures are low the main feeding grounds are further south and this favours high production of "short trip" fish, i.e. 1 + SW salmon (grilse), that return as younger fish and during the summer months. When northern sea-temperatures are comparatively warm, the main sea-feeding grounds are further north and this favours the "long-trip" fish, i.e. 2SW and older, that are older and larger because of longer sea-feeding, and that return earlier (i.e. as spring fish).

This reasoning points to the sea environment as the "dynamic" factor and the river environment as the "passive" factor involved. This may be true but there are two possible qualifications: (a) Climatic change is more easily monitored in Arctic and sub-arctic regions where such change is more pronounced than in Scottish salmon rivers: possible changes that may be caused periodically to the Scottish environment, affecting e.g. rate of parr growth, by northern hemisphere climatic changes are not yet well-recorded. (b) River-environment may be the more "passive" element of the two, but changes

possibly caused by sea-environment could effect changes in the return migration only within strictly limited tolerances established by river-environment. For example, a grilse river of the Scottish west coast could not be turned into a river frequented by equivalent quantities of large 3SW fish. Study of the variations that have taken place over the past 200 years or so tend strongly to confirm that they occur within existing frameworks established by river environment factors. In this sense the river creates the run; and sea environmental changes would be powerless to change the basic river environment framework.

It is customary to state that the freshwater environment is less stable than the sea-water environment, but as regards numbers and sea-age of salmon, modest changes in the sea could in principle have a radical effect on the numbers of fish that return. Mortality between smolt and returning adult is in excess of 90% so small changes in survival could have large effects on numbers of returning adults. Modest variations in sea environment could have major influences on amounts of food, density of competitors, identity and composition of predators. Much more research is needed into climatic change and actual and probable environmental change resulting therefrom before the complete picture can be formed.

In conclusion, the foregoing seems to offer the most rational interpretation, from the evidence of the thesis, of the nature and causality of the Scottish Atlantic salmon return-migration. It is an account of what are believed to be the various genetical strains of salmon, or at least some of the more important ones, and the great

effect on them from time to time made by environmental changes. However, there is a theoretical counterpart, from the environmental point of view, to the most extreme and rigid genetical theory mentioned earlier, and it is perhaps wise to mention what are believed to be its main constituent elements, not because it is believed that this "pure" environmental theory is correct, but because the Scottish salmon return-migration and its causality may well prove to be a more subtle or complex blend of genetical and environmental factors than provided for here.

The main constituent elements of the "pure" environmental theory are that: (a) the same breeding stock changes over from salmon to grilse periodically as a result of exclusively environmental factors; (b) the variations in the types of salmon run from river to river are exclusively the result of environmental factors (e.g. size, volume and length; chemistry and geology); (c) migrations through big river systems are solely the result of the timing of the runs through the rivers, e.g. the 3SW winter-spring stock of the upper Tay system exists solely because the 3SW stock (or part of it) is the earliest of all the Tay system migrations, and of all Scottish salmon migrations generally, and therefore the fish have ample time to reach the top-most spawning reaches of the system; that the late-spring and early-summer running 2SW, 2 + SW and 1 + SW stocks largely frequent the middle reaches of the system and its spawning tributaries, and that the late-summer and autumn-migrating 1 + SW and 2 + SW and older fish adhere (as in most sizeable rivers) to the lower - and lower-middle main river and its spawning tributaries, because after about late July or early August

they rapidly become too gravid to migrate over long distances in a river with many fast and obstacle-strewn reaches.

It seems possible that much of the traditional debate of genetics versus environment may ultimately appear somewhat circular, in that there is a genetical component and there is an environmental component involved in the causality of the return-migration, but that, since selection by the environment leads to differential mortality of fish with different genetical constitutions, the search for genetical final causes, as traditionally conceived, tends to make little real progress.

Asymmetry: Intercyclical Lack of Compensation

It seems clear that there are, or there may be from time to time, asymmetrical forces at work that result in a lack of compensation in some districts when a grilse-dominance changes to a salmon-dominance, or vice-versa, in the total return migration.

Over the past hundred years or so, for which more detailed statistics are available, it seems that there has been a basic asymmetry by sea-age in the Scottish return-migration. The nature of this asymmetry may be summarised as follows:

1. Grilse dominated cycles accrue to all river systems (though not necessarily to all sub-systems of systems).

2. Salmon (i.e. older fish) dominated cycles accrue essentially to salmon rivers.

This hypothesis explains why, for example, in the 1930s, when the rods and nets of the Scottish east coast rivers were catching salmon in large quantities, the produce of the (grilse) rivers of the west and the north was small compared to their produce forty years before in

the 1890s, at the end of the previous grilse cycle. The Fishery Board for Scotland's Annual Reports throughout the 1920s and 1930s are a catalogue of west and north coast decline, contemporaneous with the development of the great early-running salmon cycle on the east coast.

The east coast, too, was very short of grilse at this period, but obtained great salmon compensation. The west coast lost most of its grilse but received small salmon-compensation, except in its few big river systems, e.g. Awe-Orchy, Lochy, and a few of the Solway rivers. Even the latter, except for the Eden, did not receive salmon-compensation representing anything like its grilse loss.

The supporting regional statistics for the commercial catch are in Table 90, covering 1894-1934.

In relation to more recent experience, the concept of asymmetry explains why, although the Scottish salmon (i.e. older fish) migration was in galloping decline throughout the 1960s, the official average annual rod catch increased gradually from 51,629 over the five years 1952-56 to 76,950 over the five years 1962-1966, largely because of increased catches of grilse all round the coast, following the start of the next great grilse cycle from 1957.

The reverse of the west coast deterioration, following the end of the grilse cycle in the 1890s, is demonstrated in Table 133, showing the rapid improvement experienced in these districts with the development of the grilse cycle. The statistics are by number instead of by weight, but the trend is clear, and is summarised as follows. (The salmon and grilse numbers are combined because the "grilse error" rectification carried out on the whole of the Scottish nets catch has

not been performed on the individual district nets and rods catches, with the result that by 1962-1966 many heavy grilse were being classed as salmon in the records.)

Numbers of Salmon and Grilse caught by Nets and Rods combined during 1952-1966 in the North-Western, the Western and the South-Western Districts of Scotland extending from the River Hope round to the River Annan.

Five-Year Averages	Numbers
1952 - 1956	46,342
1957 - 1961	64,644
1962 - 1966	90,331

Why this asymmetry by sea-age can exist in the Scottish salmon fishery, i.e. why the grilse districts of the west and north should get small salmon-compensation during salmon-dominated cycles, is not absolutely clear, but is probably associated with the different genetic stocks as influenced by environment (climate) outlined in "Factors Influencing the Return Migration". The result is that whenever the main sea-feeding grounds move north and favour an abundance of "long trip" fish, i.e. salmon, the "short trip" fish, i.e. grilse, rivers and districts simply lose out, because they are not biologically salmon-producing, except at the margin.

It may be pointed out that the main district for salmon-compensation on a massive scale is on the east coast from the Ness down to the Tweed, but that also there is a number of rivers in the far north-east of Scotland, between Beauly and Naver, that are in varying degrees

more balanced salmon and grilse rivers; these adhere to the cycles by sea-age, but to a rather less marked degree, except during the peak years of a cycle.

There are other, but more local, forms of asymmetry. For example, the 3SW winter - and early-spring migrating stock of the upper Tay system beyond Loch Tay thrives during salmon-dominated cycles, but during grilse-dominated cycles it substantially declines and appears to receive negligible compensation, except possibly from a small increase of grilse. (There are always some 2SW fish, in varying quantities according to the cycle, in this sub-system.)

Variations in the Speed of River-System Penetration

There are many indications that salmon vary the speeds at which they migrate through river systems from period to period, particularly the spring runs. When they occur these changes appear to be independent of river temperature variations but may be connected with shoaling habits and quantities of kelts in the rivers. The writer is gathering statistical evidence via beat rod catches and their incidence in a number of rivers over long periods of time with a view to demonstrating such changes, their nature and significance. The numbers of salmon caught by the rod in different reaches of rivers are greatly affected thereby.

U.D.N. Salmon Disease

A severe epidemic of U.D.N. salmon disease in Scotland from 1966 and, at an earlier period, from 1878, did not appear to have a very marked numerical affect on the return-migrations ensuing from the years of virulent disease and mortality, measured in terms of the netting returns. Both epidemics took place and thrived at periods when netting catches and the total numerical return-migrations were heavy, i.e.

1880-1885, 1966-74. This may indicate that U.D.N. becomes epidemic at times when there are big stocks of fish. It seems also to indicate that, in the great majority of systems at least, enough spawning fish remained alive long enough to stock the rivers adequately with fry and smolts (unlike the sea-trout stocks which suffered heavily in some river systems). An gling sport did, of course, suffer considerably at both periods.

The period 1967-74, during which disease was worst, witnessed very heavy runs of grilse. It appears to be a characteristic of great grilse periods that the numerical return-migration is much larger than the numerical migration during a salmon-dominated period, because many more of the 1SW fish survive to return than 2SW and older stock. This is one reason, and perhaps the main one, why the numbers of fish held up in the nets' catches in the years immediately subsequent to the disease outbreak in 1966.

SUMMARY OF CONCLUSIONS

Variations by Sea-Age

The thesis starts in the mid-1780s with statistical and other indications of modest runs of salmon and poor runs of grilse. The main variations by sea-age in the return migration over the period circa 1790 to 1976 are as follows:-

1. Circa 1787 to 1811 was a salmon-dominated period.
2. The grilse run increased slowly from 1790 until 1811. In 1812 the increase accelerated rapidly.
3. During 1812 to 1817 there were heavy runs of both grilse and salmon. After 1817 the salmon run declined.
4. The three decades 1820-1849 were dominated by heavy grilse runs.
5. From the 1850 season the great grilse runs declined. 1850-1861 experienced a generally poor total return-migration, but with indications of a modestly increasing salmon run combined with a continuing decline of grilse.
6. From 1862 the salmon increase, more particularly the average weight of salmon, became more obvious. The grilse continued to decline.
7. The grilse decline ceased during the later 1860s and the run stabilised in many districts.
8. Salmon continued to increase slowly during the 1870s reaching a peak during the early 1880s.
9. The grilse run increased rapidly from the 1881 season and the period 1881-1896 generally experienced big grilse runs, particularly dominating the salmon after 1885.
10. From 1886 Salmon declined rapidly, and/or became later-running, i.e. heavy runs after the close of the net fishing. The reduced/

later salmon runs endured from the mid-1880s through to the second decade of the present century.

11. Grilse rapidly declined after 1896, reaching a nadir during 1915-1929, according to district. Numbers of grilse running were substantially fewer than salmon then. In 1930 and during the 1930s the grilse run improved modestly. During the 1940s the run again declined to a low level.

12. From the opening years of the present century the salmon run started to become earlier. From 1920 this trend accelerated and from the 1921 season the quantities of salmon greatly increased, particularly in the main east coast district from the Moray Firth down to Tweed.

13. Throughout the 1920s the salmon run continued to increase and to become earlier, this combined trend reaching a peak during the 1930s.

14. From the late 1930s and during the 1940s the salmon declined, but started to increase again towards the end of the 1940s. During the 1950s and the early 1960s the salmon run was generally buoyant.

15. From 1957 the grilse run began to increase, and this increase accelerated from 1962.

16. From the later 1950s in some districts, and from the early 1960s generally, the salmon run began to decline.

17. From 1962 to 1968 there was a numerically big combined return-migration of grilse and salmon.

18. After 1968 the salmon run declined rapidly.

19. From 1969 to 1976 the return-migration was dominated by heavy grilse runs.

Consequently:-

(a) Salmon - or grilse-dominated cycles may be of relatively short or long duration, up to several decades.

(b) Exceptional numbers of fish in the total return-migration are often associated with periods when two cycles coincide for a few years, one declining and the other increasing, but at stages when both the salmon and the grilse cycle are still substantial. For example, 1812-17; 1881-85; 1962-68.

(c) The experience of the nearly 200 year period c.1790-1976 does not necessarily exhaust the possibilities. Much of this period, even from as far back as the 1790s, has been subject to marked fluctuations of climate in the northern hemisphere. It is possible, for example, that the considerably colder seventeenth and eighteenth centuries may have experienced both different and more consistent patterns of return-migration by sea-age.

Variations by Time

Periodic variations in the seasonal timing of the return-migration affects salmon far more than grilse. The main variations over c.1790-1976 have been:-

Salmon

1. During c.1790-c.1817 the main salmon run took place during the spring and summer months between March/April and July/September according to district.

2. From c.1818 to c.1860 the timing of the salmon migration was not markedly dissimilar to 1790-1817, but with a decrease of spring-running stock and a greater concentration of the residual

salmon run into the summer months during the great grilse cycle up to the 1850s.

3. From 1860 the general salmon run, at an expanding phase, tended to spread out over the season once again, with greater quantities of 2SW and 3SW spring and summer fish according to the main nature and characteristics of each river (e.g. more 2 and 3SW fish of all classes in the Tay; more 2 + SW summer fish in the Tweed; more small 2SW spring fish in the Dee.)

4. Through the latter part of the century, gradual at first, accelerating towards the end of the century, the main salmon run gradually became later, particularly in the principal Spey-Tweed east-coast region, with large quantities of fish running from August to as late as December and January.

5. From the early years of this century, and from the second decade particularly, the salmon run became much earlier, unprecedentedly so during the 200 years under review. Big winter runs of clean fish developed in many of the major river systems, continuing throughout the spring, the main salmon run being over by June or July, according to district and season. This period lasted until the 1950s or early 1960s according to river and district.

6. Since c.1960 up to 1976 there has developed a tendency for the residual salmon run to become rather more concentrated into the summer months once again, during the great grilse cycle of the 1960s and 1970s.

Grilse

When grilse are numerous there is a tendency for the run to spread out over the summer and early autumn months from a peak late in

July. When grilse are few in number there is a tendency for the run to be concentrated within a shorter period of time. The main variations during 1790-1976 were as follows:-

1. Many indications point to a run that was July and early August based during the late eighteenth and the nineteenth centuries up to the 1860s, according to district and river.

2. From the later 1860s and the beginning of the 1870s indications from some rivers are that the grilse run was becoming later or extending longer. During the heavy grilse runs of the 1880s there are many records of autumn-running grilse in considerable quantities.

3. Over the twenty years between 1900 and 1920 the grilse run gradually became much earlier, with June taking over from August as the second main month.

4. Between 1920 and the 1950s the grilse run was June and July based. In some rivers more fish ran in June than July during many seasons.

5. From 1962 particularly the grilse run began to spread out over the summer months and become rather later once more. This tendency accelerated from the 1969 season, and during the 1970s particularly there were considerable numbers of late-summer and autumn-running grilse.

Variations by Weight

Variations in the average weight of salmon by sea-age and of grilse occur from period to period.

In the case of grilse, average weights are usually though not invariably heavier during years of big grilse migrations, such as

occurred in many seasons during 1881-1896 and 1962-1974. On the evidence available this characteristic may not have been so marked during the grilse-dominated decades of 1820-1849. It also seems possible that grilse may weigh as heavy when quantities are modest (e.g. the 1870s) as when very numerous (e.g. the 1840s).

Salmon weights by sea-age are more complex to analyse, and information is not available in this thesis to draw firm conclusions. It does appear that salmon monthly average weights by sea-age vary within quite wide bands from period to period. Whether or not these bands are random or may be assimilated to the grilse weights by the development of a suitable hypothesis with adequate evidence remains to be seen.